National Aeronautics and Space Administration

HIGH-END COMPUTING CAPABILITY PORTFOLIO

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NASA Advanced Supercomputing Division

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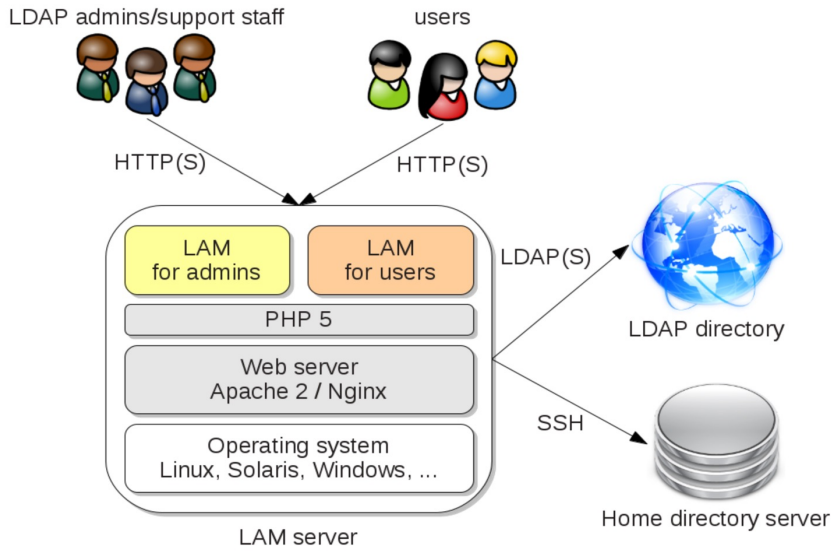
HECC Completes Major Milestone in Replacing LAMS

- The HECC Engineering Systems & Services, Tools, and Supercomputing Systems teams jointly completed a major milestone to replace the legacy Local Account Management System (LAMS) with new industry standard tools to manage LDAP (Lightweight Directory Access Protocol) and resource allocation. LAMS had been used for more than 20 years and was no longer maintainable.
- The new LAM (LDAP Account Manager) system is an open-source web-based front end for managing entries (such as: users, groups, and hosts) stored in an LDAP directory.
- As part of the milestone work to replace and retire LAMS, the teams:
  - Migrated all user and group accounts to the the recently implemented LDAP infrastructure.
  - Installed and configured the LAM tool.
  - Identified and updated Tools group scripts.
- The Tools team also developed and implemented a custom tool, the NAS Users/Group Manager, to manage resource allocation data for user groups on NAS systems
- Moving to new industry standard tools to manage LDAP and resource allocation is a major improvement—these tools are user friendly, easily maintainable, and upgradable.

IMPACT: Moving to new standard tools to manage LDAP and resource allocations provides an improved user experience and the ability to add new features easily in the future; and reduces the labor time required to maintain the old system.

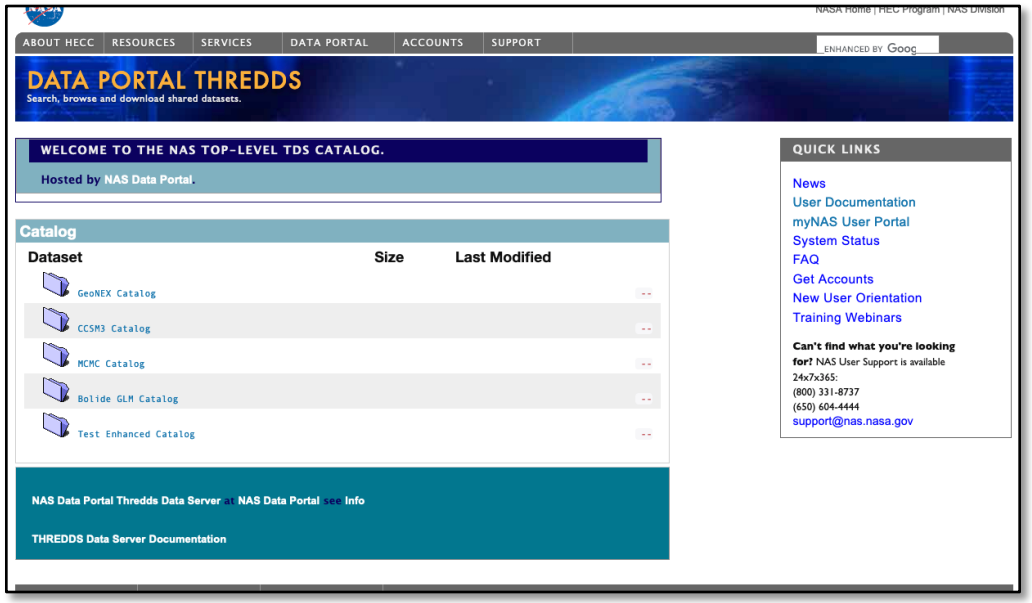


LAM workflow: Users connect to the LDAP Account Management (LAM) front end using a web browser. The web server runs on Apache/PHP, which connects to the LDAP directory using the standard Lightweight Directory Access Protocol. *Image courtesy of LDAP Account Manager*

Big Data Team Launches NAS THREDDS Server

- HECC's Big Data Team launched the NAS THREDDS Server, a web server that allows users to download subsets of the scientific data available on the NAS Data Portal.
- The THREDDS Data Server was developed by Unidata (a member of UCAR, University Corporation for Atmospheric Research) to compile various data formats into a Common Data Model and provide the data formats through a catalog service.
  - External users can browse available datasets through a web interface and download files using a variety of remote access protocols.
  - THREDDS serves gridded data in GeoTIFF or netCDF format, allowing Web Coverage Service (WCS) clients to specify a subset of a gridded dataset, gather metadata information, and/or visualize the extracted data through common scientific visualizing software packages.
- HECC users can request access to their shared datasets through the THREDDS server.
- Dataset owners can request that their data be hosted on THREDDS server using the dataset submission form.
- THREDDS leverages existing Data Portal assets.
  - Re-exporters used to make datasets available outside of the HECC enclave will be extended to provide THREDDS catalogs.

IMPACT: HECC users and collaborators can leverage the functionality of the THREDDS Data Server to incorporate data into their workflow more efficiently, further promoting the Data Portal's goal of enabling scientific discovery.

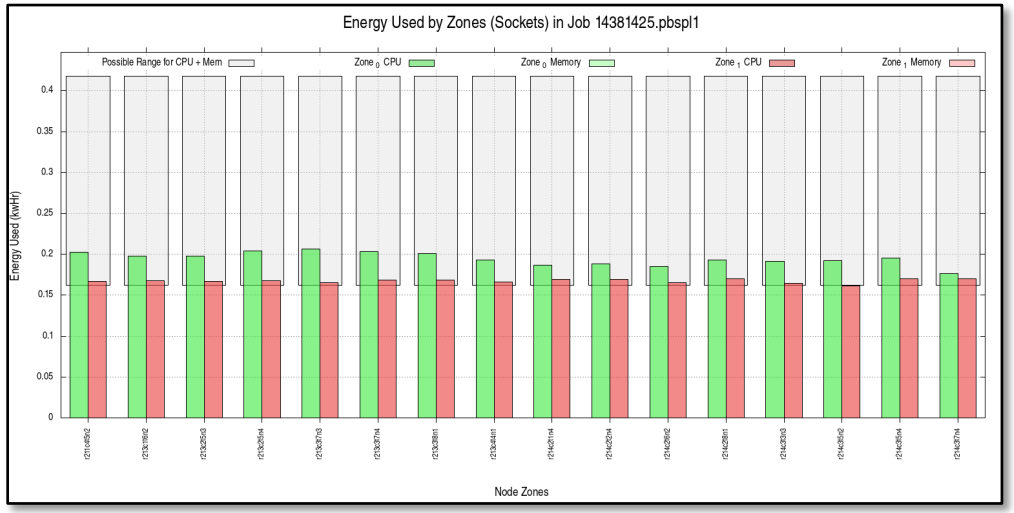


NAS THREDDS Server web interface, which allows users to navigate through customized catalogs and choose files to access. Users can also download full or partial datasets via application program interfaces.

Power Monitoring Capability Extended on HECC Systems

- Tools for monitoring the power consumption of Intel-based HECC compute nodes have been in place for some time. Now, for the first time at the NAS facility, this capability is extended to the AMD "Rome" nodes on the Aitken supercomputer.
- Because the Intel and AMD nodes do not have compatible access to power consumption information, HECC's Application Performance and Productivity team:
  - Devised a new power measurement methodology for the AMD nodes. This was difficult to develop due to recent increased security restrictions placed upon the reading of power information.
  - Implemented a novel and innovative approach that made it possible to devise and test the new methodology prior to placing the subsystem into production.
- Now that power information is available for jobs running on the AMD nodes, these nodes can be included in routine searches for jobs that display load imbalance, shown via the imbalance of power consumption by the different processors within a node. This ensures that HECC compute resources are being utilized efficiently.

IMPACT: Extending the capability to power monitor user jobs allows HECC staff to identify and remedy load imbalances of users' codes on a larger portion of the Aitken supercomputer.



Example power usage graph showing reduced utilization of the second socket. *Robert Hood, NASA Advanced Supercomputing Division*

Systems Team Improves Resilience of Aitken InfiniBand

- HECC's Supercomputing Systems team improved the resilience of the InfiniBand (IB) network connected to the Aitken supercomputer by making changes to a critical IB component, the subnet managers.
- IB subnet managers provide a management service that enables an IB network to route traffic and respond to system events.
- HECC systems experts installed additional IB connections to the Aitken subnet managers and enabled a new feature that allows the subnet managers to gracefully failover to a secondary connection when the primary connection is lost.
- Previously, if a subnet manager lost its IB connection, there was a possibility that the Aitken IB network could degrade and impact users' jobs through such events as PBS job termination and filesystem interruption.
- The Systems team will deploy this improvement to the subnet managers for Pleiades and Electra as well.

IMPACT: HECC continues to deploy the latest advancements to InfiniBand networks to improve resilience and maintain reliable access for NASA's scientific and engineering users.

The Aitken supercomputer, housed at the Modular Supercomputing Facility at Ames Research Center. *Derek Shaw, NASA/Ames*

NASA's Supercomputing Superheroes Shine at SiliCon

- For the fourth year, a team of HECC researchers and support staff produced an outstanding outreach exhibition in the NASA booth, the star attraction and largest at the SiliCon with Adam Savage event, held August 27–28, 2022.
  - The exhibit was featured as part of an extensive NASA presence at the event, which included a full-scale model of the VIPER mobile robot, five NASA panels, and a guest appearance live from the International Space Station (ISS) with ISS Mission Commander Kjell Lindgren.
  - The event hosted an estimated 60,000 attendees, and HECC staff greeted thousands who were eager to speak with experts on subjects as large as the Artemis project and as small as how to build your own Raspberry Pi cluster.
- On a 65-inch monitor in the HECC exhibit, our browser-based "Video Jukebox" tool shared five stunning results of simulations run on HECC systems, including: Urban air mobility, ECCO ocean modeling, noise and vibration of landing gear, and Artemis booster separation, and Artemis rocket ignition on launchpad.
- NAS researcher Derek Dalle was featured in the panel, "Artemis: The First Step in the Next Era of Human Exploration"; and NAS aerospace engineer Ashley Coates was featured in the panel, "Getting Your Start at NASA: All About Internships at the Agency" in the 1,000-seat Grand Ballroom.
- Ames Center Director Eugene Tu visited the HECC exhibit, along with notable celebrities including host Adam Savage, Christopher Lloyd, Summer Glau, Ray Park, Shohreh Aghdashloo, Kari Byron, and Tory Belleci.

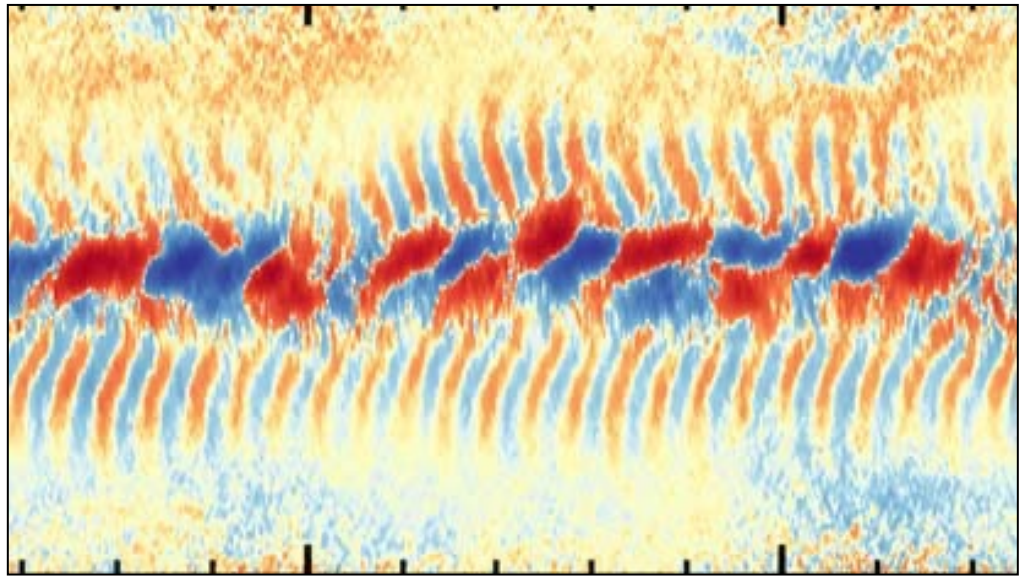
Impact: NASA's exhibit at SiliCon provided an excellent public outreach opportunity to highlight the critical role of HECC resources in NASA science and engineering.

The HECC exhibit in the NASA booth attracted thousands of attendees at the SiliCon, including Eugene Tu, NASA Ames Center Director. *Blaise Hartman, NASA/Ames*

Simulating the Many Personalities of Our Sun*

- Using 3D magnetic fluid simulations, researchers at the University of Colorado Boulder developed models that capture several features of solar magnetism and the propagation of magnetic flux toward the poles.
- Simulations run on Pleiades achieved remarkable dynamo behaviors much like observed features of the solar cycle:
  - A highly regular system of four "magnetic wreaths"—tubes of magnetic flux that wrap all the way around a magnetized spherical shell in a large torus—steadily migrate toward the solar equator and regularly reverse their polarity, similar to the butterfly pattern found in the 11-year sunspot cycle.
  - The poloidal magnetic field eventually bifurcates: the system of four wreaths persists and cycles, but a new system of partial wreaths, each of opposite polarity, coexists superimposed on the original system.
  - The simulations suggest that the Sun may be a chaotic dynamical system residing in a state of bistability—a bifurcation regime in which two distinct dynamos can operate simultaneously or in superposition.
- These simulations show the role of HECC's advanced computing infrastructure in solving large problems, such as the complex and often chaotic solar dynamo.

IMPACT: These simulations provide major insights into how the solar dynamo operates and show that our Sun potentially exists in a "bistable" state, where distinct magnetic structures cycle in superposition.



Closeup of an extended time-latitude diagram of the simulated Sun's azimuthal magnetic field at mid-convection zone. *Loren Matilsky, Juri Toomre, JILA / University of Colorado Boulder*

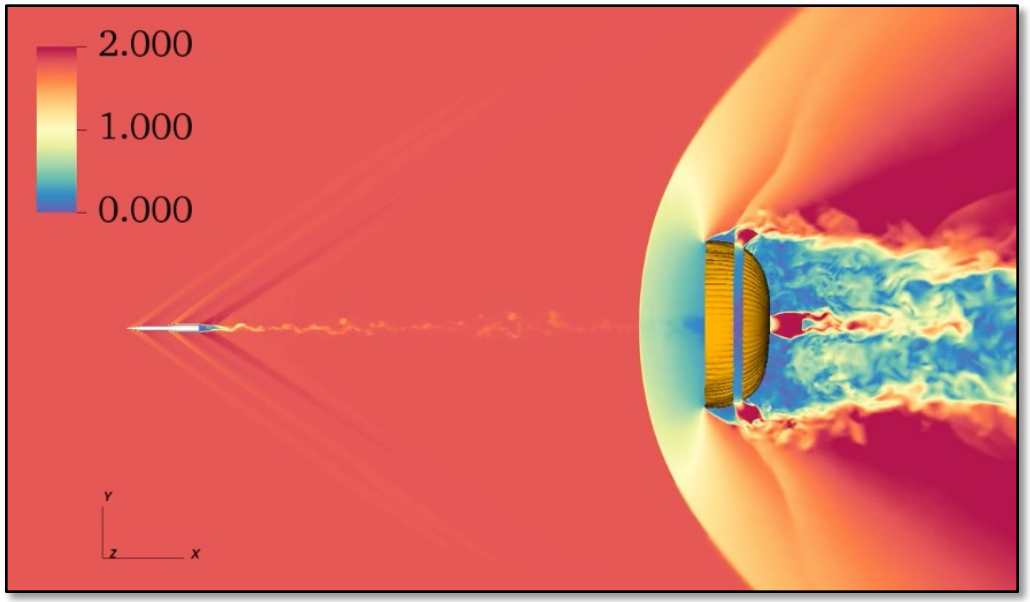
** HECC provided supercomputing resources and services in support of this work.*

Simulated Supersonic Parachute Inflation for Mars Landing*

- Understanding the inflation process of parachutes at supersonic speeds is a challenge that NASA has been tackling since the 1960s, through flight and wind tunnel tests. As part of agency efforts to reduce reliance on expensive testing, the Launch Ascent and Vehicle Aerodynamics (LAVA) team in the NASA Advanced Supercomputing Division was tasked by the Entry Systems Modeling project to assess current computational capabilities for supersonic parachute inflation of Mars entry, descent, and landing systems.
- To validate the LAVA flow solver, the team simulated several flight tests at supersonic conditions and compared results to experimental data. The tests included the Advanced Supersonic Parachute Inflation Research Experiment (ASPIRE) project, which helped the engineers at the Jet Propulsion Laboratory select a design for the Perseverance rover's parachute.
- The team looked into many factors, including the permeability of the broadcloth material and the starting shape of the parachute, to improve simulation accuracy of the aerodynamic loads on the structure.
- A typical simulation for a half-second period of inflation could run for a week on more than 2,500 Cascade Lake cores on the Aitken supercomputer, producing several dozen terabytes of data. Their parametric studies required tens of thousands of cores to complete and generated several hundreds of terabytes of data.

** HECC provided supercomputing resources and services in support of this work.*

IMPACT: Continual improvements to computational tools such as LAVA will help reduce costs while increasing the safety and performance for future supersonic and subsonic parachute design and validation for NASA exploration missions.



Mach numbers around an inflating parachute and rigid payload from a simulation of ASPIRE's first flight test. Supersonic jet flow can be seen exiting from the gap and vent of the parachute, and a strong bow shock forms ahead of the canopy as the area exposed to the oncoming flow is increased. *Jonathan Boustani, NASA/Ames*

Papers

- "**Evaluation of Polar Winter Mesopause Wind in WACCMX+DART**," V. L. Harvey, N. Pedatella, E. Becker, C. Randall, Journal of Geophysical Research: Atmospheres, vol. 127, issue 15, August 3, 2022. *
  https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2022JD037063
- "**Antarctic Calving Loss Rivals Ice-Shelf Thinning**," C. Greene, A. Gardner, N.-J. Schlegel, A. Fraser, Nature, August 11, 2022. *
  https://www.nature.com/articles/s41586-022-05037-w
- "**TOI-2196 b: Rare Planet in the Hot Neptune Desert Transiting a G-Type Star**," C. Persson, et al., arXiv:2208.05797 [astro-ph.EP], August 11, 2022. *
  https://arxiv.org/abs/2208.05797
- "**HD 56414 b: A Warm Neptune Transiting an A-Type Star**," S. Giacalone, et al., The Astrophysical Journal Letters, vol. 935, no. 1, August 12, 2022. *
  https://iopscience.iop.org/article/10.3847/2041-8213/ac80f4/meta
- "**Antarctic Peninsula Warming Triggers Enhanced Basal Melt Rates Throughout West Antarctica**," M. Flexas, et al., Science Advances, vol. 8, no. 32, August 12, 2022. *
  https://www.science.org/doi/full/10.1126/sciadv.abj9134
- "**Three New Brown Dwarfs and a Massive Hot Jupiter Revealed by TESS around Early-Type Stars**," A. Psaridi, et al., Astronomy & Astrophysics, vol. 664, August 12, 2022. *
  https://www.aanda.org/articles/aa/full_html/2022/08/aa43454-22/aa43454-22.html

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Papers (cont.)

- "**TOI-836: A Super-Earth and Mini-Neptune Transiting a Nearby K-Dwarf**," F. Hawthorn, et al., arXiv:2208.07328 [astro-ph.EP], August 15, 2022. *
  https://arxiv.org/abs/2208.07328
- "**Precise Mass Determination for the Keystone Sub-Neptune Planet Transiting the Mid-Type M Dwarf G 9-40**," R. Luque, et al., arXiv:2208.07287 [astro-ph.EP], August 15, 2022. *
  https://arxiv.org/abs/2208.07287
- "**High-Contrast Imaging of HD 29992 and HD 196385 with the Gemini Planet Imager**," L. García, R. Petrucci, E. Jofré, M. Gómez, Monthly Notices of the Royal Astronomical Society, vol. 515, issue 4, published online August 17, 2022. *
  https://academic.oup.com/mnras/article-abstract/515/4/4999/6670829
- "**Drag Force of a Compressible Flow Past a Random Array of Spheres**," M. Khalloufi, J. Capecelatro, arXiv:2208.09965 [physics.flu-dyn], August 21, 2022. *
  https://arxiv.org/abs/2208.09965
- "**TOI-1468: A System of Two Transiting Planets, a Super-Earth and a Mini-Neptune, on Opposite Sides of the Radius Valley**," P. Chaturvedi, et al., arXiv:2208.10351 [astro-ph.EP], August 22, 2022. *
  https://arxiv.org/abs/2208.10351
- "**Connecting Energy Input with Ionospheric Upflow and Outflow**," A. Glocer, L. Daldorff, Journal of Geophysical Research: Space Physics, published online August 25, 2022. *
  https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2022JA030635

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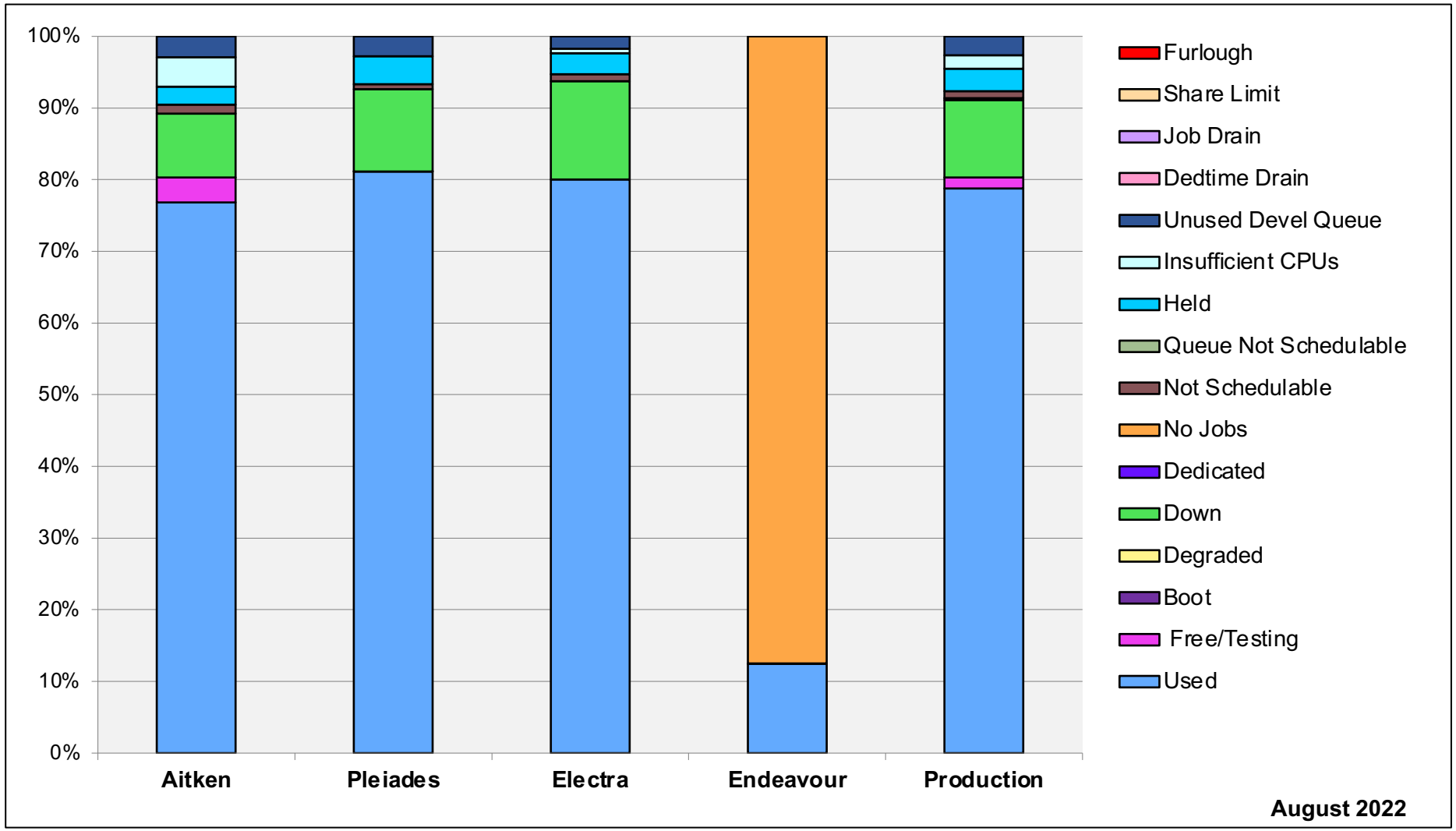
News and Events

- **Doing More with Less: NASA's Most Powerful Supercomputer**, *NASA Ames*, August 17, 2022—NASA is committed to reducing the environmental impact of its labs and facilities. The latest expansion to NASA's innovative Modular Supercomputing Facility increased NASA's computational power by 22%, making it the agency's most powerful, yet energy-efficient, supercomputer.
  https://www.nasa.gov/feature/ames/doing-more-with-less-nasa-s-most-powerful-supercomputer

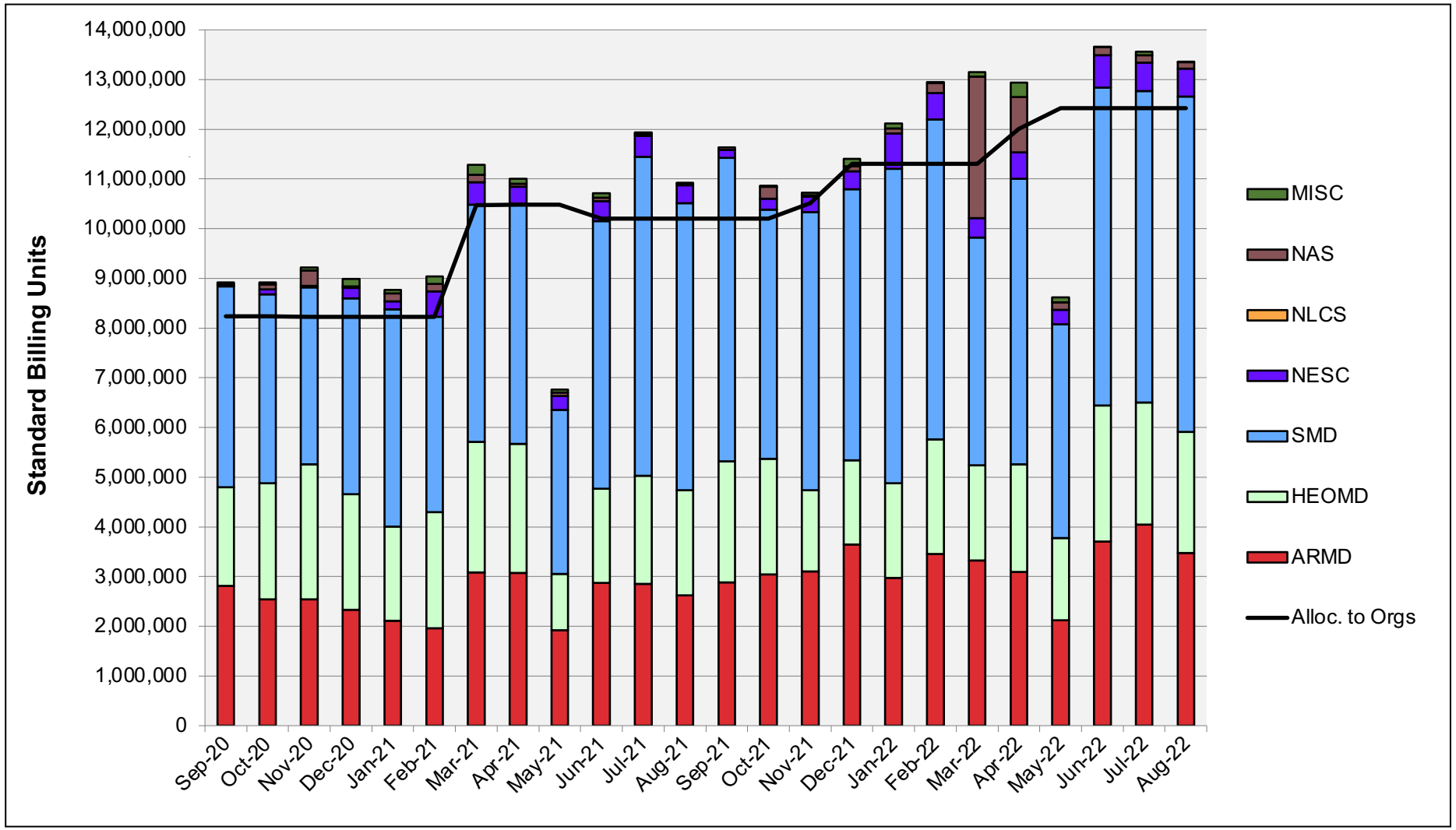
News and Events: Social Media

- **Coverage of NAS Stories**
  - SLS/Artemis Pre-Launch Campaign (Ames):
    - NASA Ames: Twitter 537 retweets, 42 quote tweets, 3,035 likes.
    - NASA Supercomputing: Twitter 3 retweets, 10 favorites
  - NASA at SiliCon 2022 Campaign:
    - NAS (Announcement): Twitter 1 retweets, 3 likes.
    - NAS (D. Dalle in NASA Artemis Panel): Twitter 1 retweets, 3 likes
    - NAS (A. Coates in NASA Internship Panel): Twitter 1 retweets, 6 likes.
    - NAS (Wrap-Up): Twitter 1 retweets, 6 likes.

HECC Utilization



HECC Utilization Normalized to 30-Day Month



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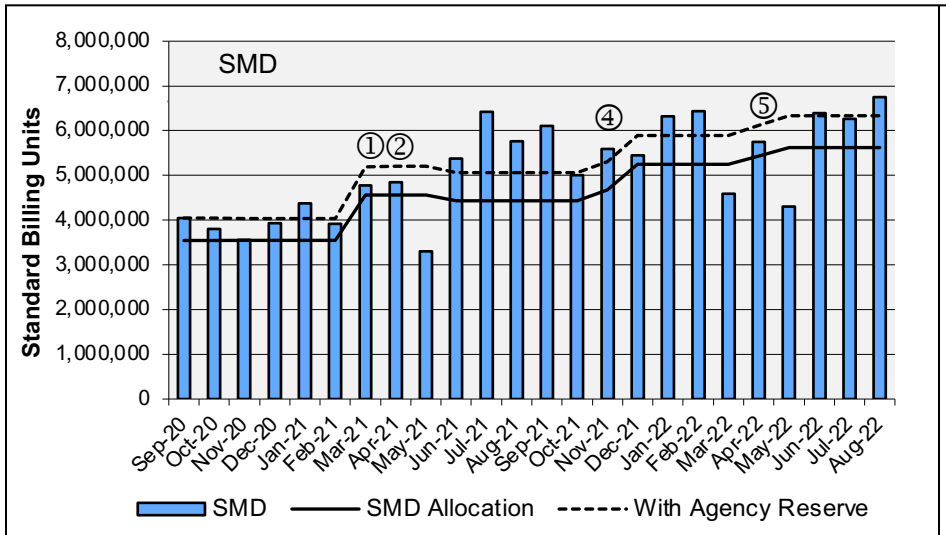
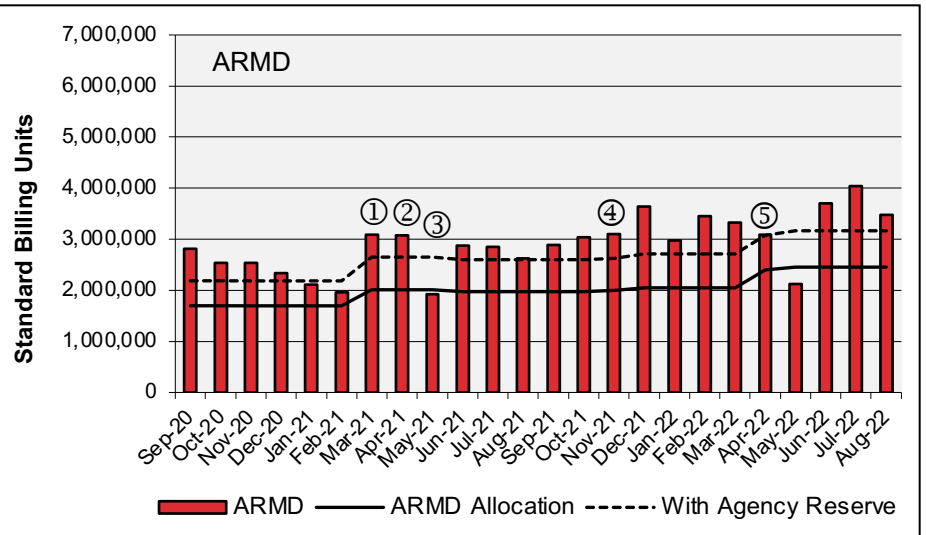
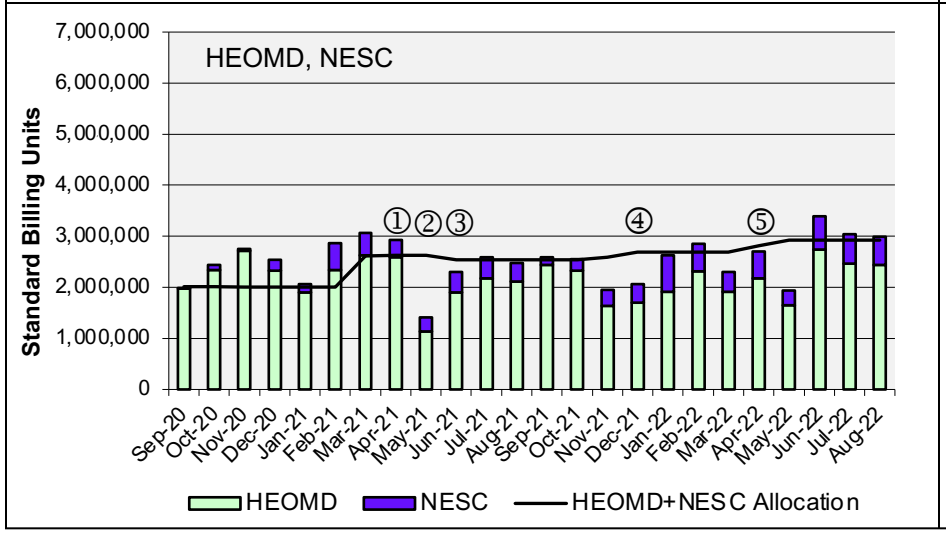






① 8 Rome Apollo racks introduced into Aitken

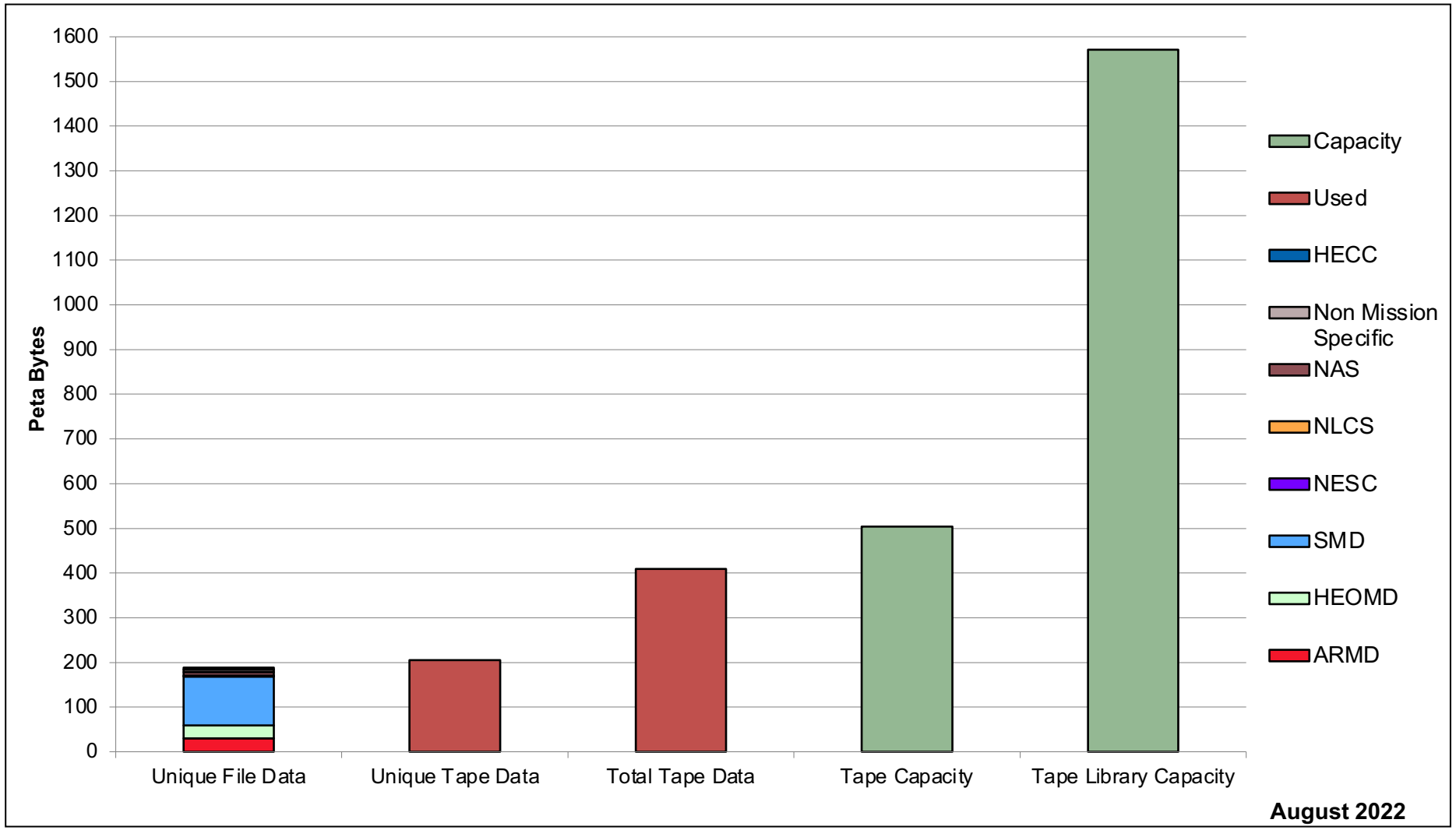
② Endeavour replaced with new hardware

③ Merope retired

④ 4 Rome Apollo Racks added to Aitken

⑤ 4 Rome Apollo Racks added to Aitken

Tape Archive Status



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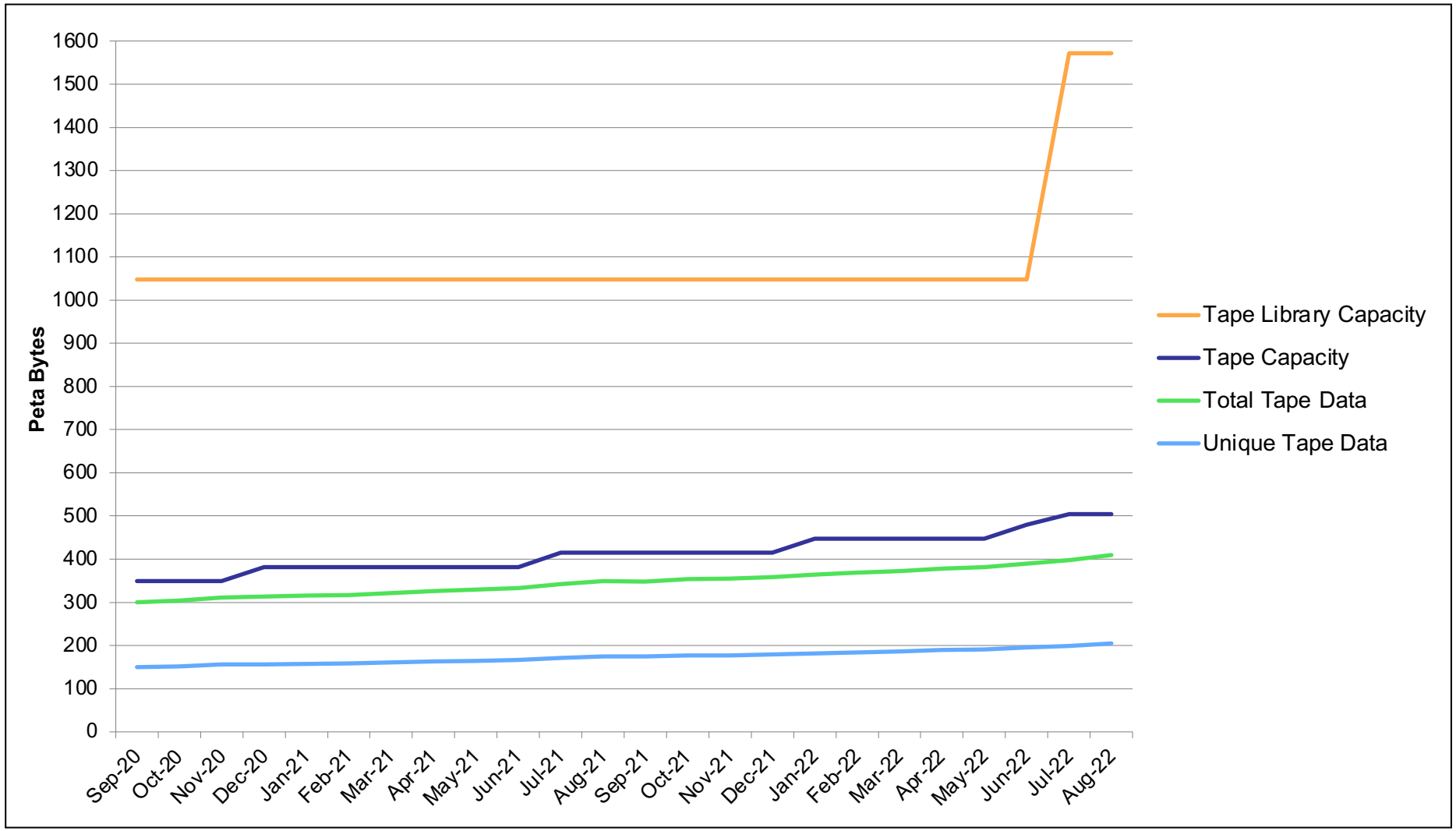
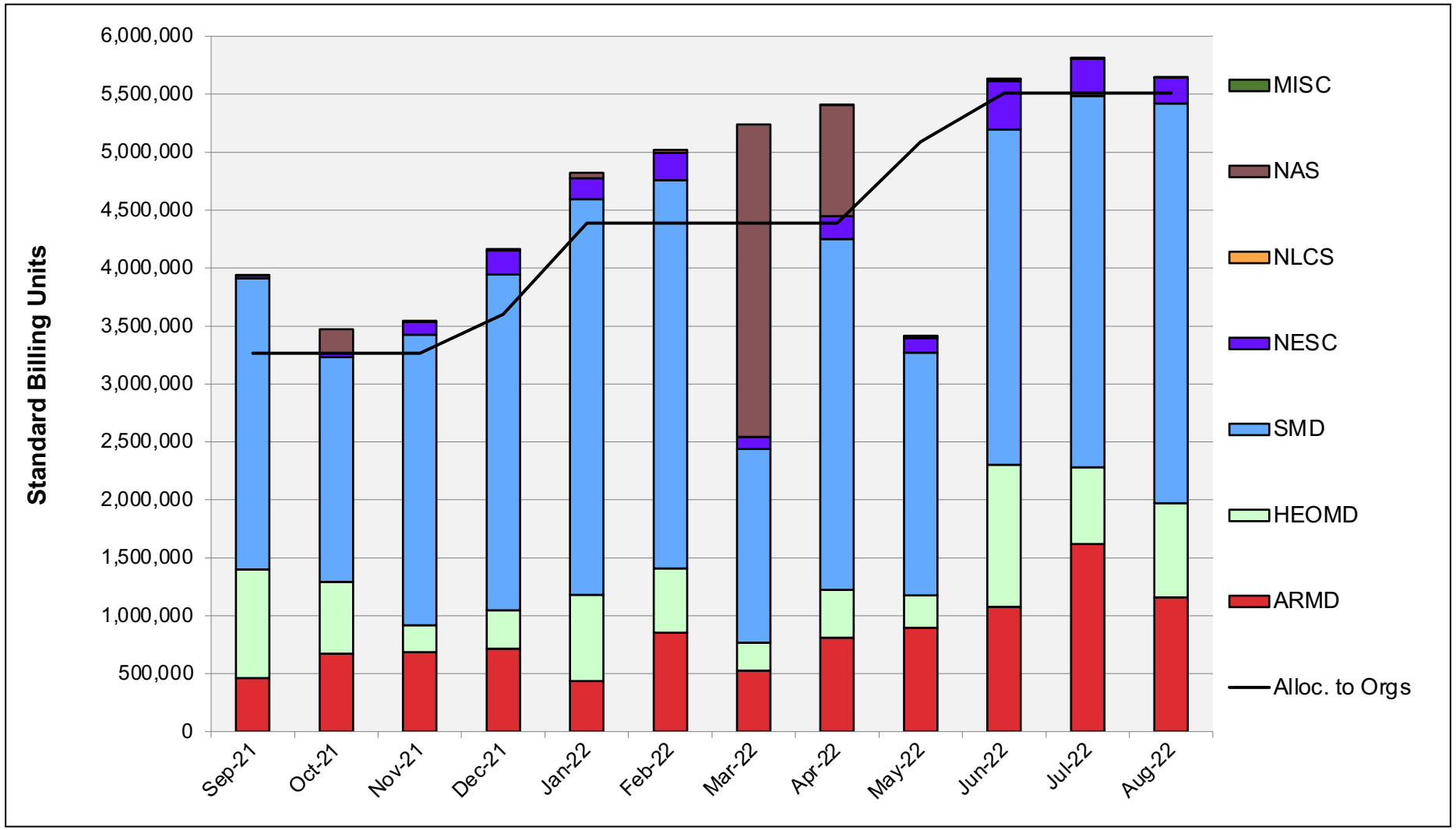
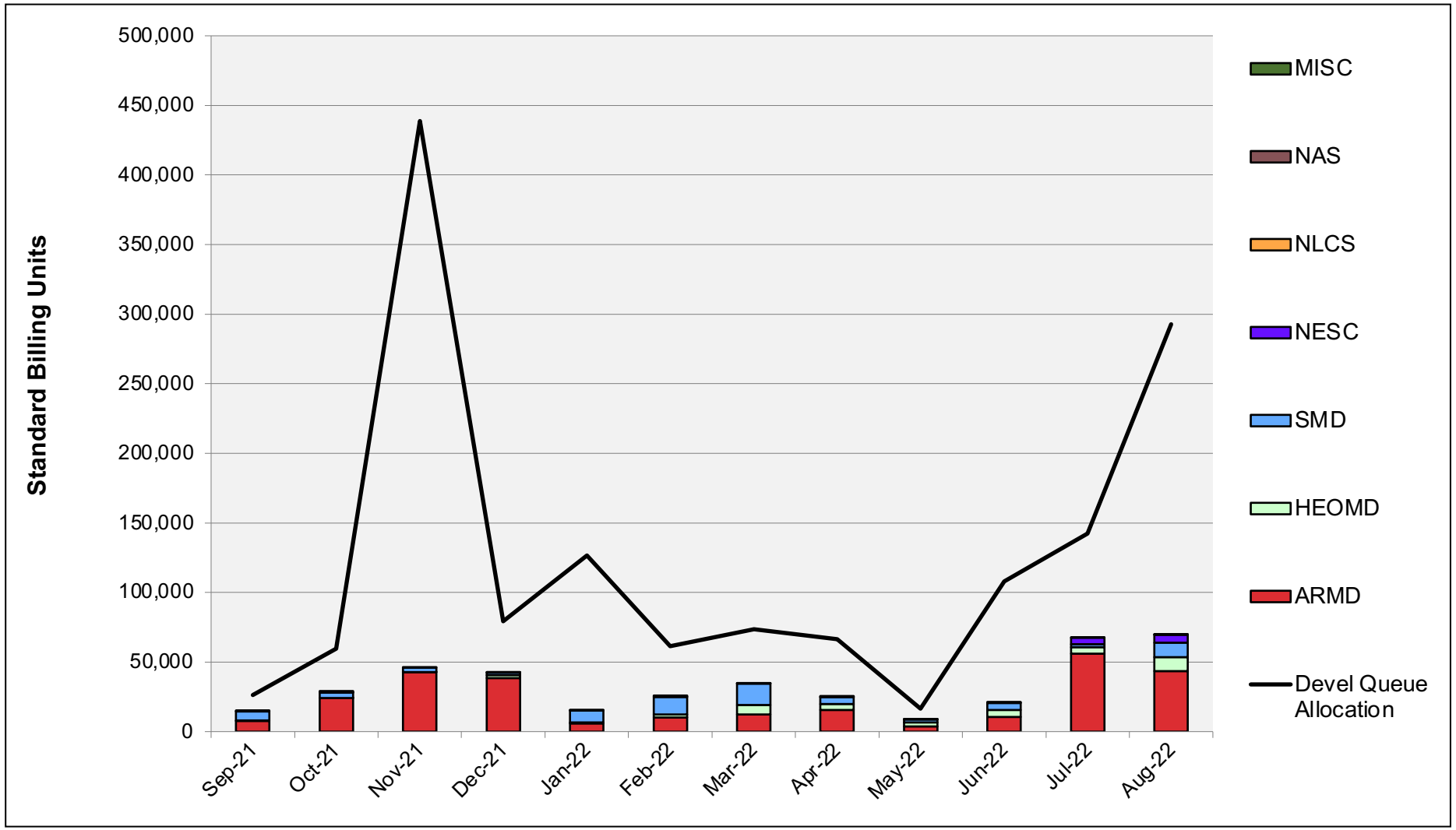


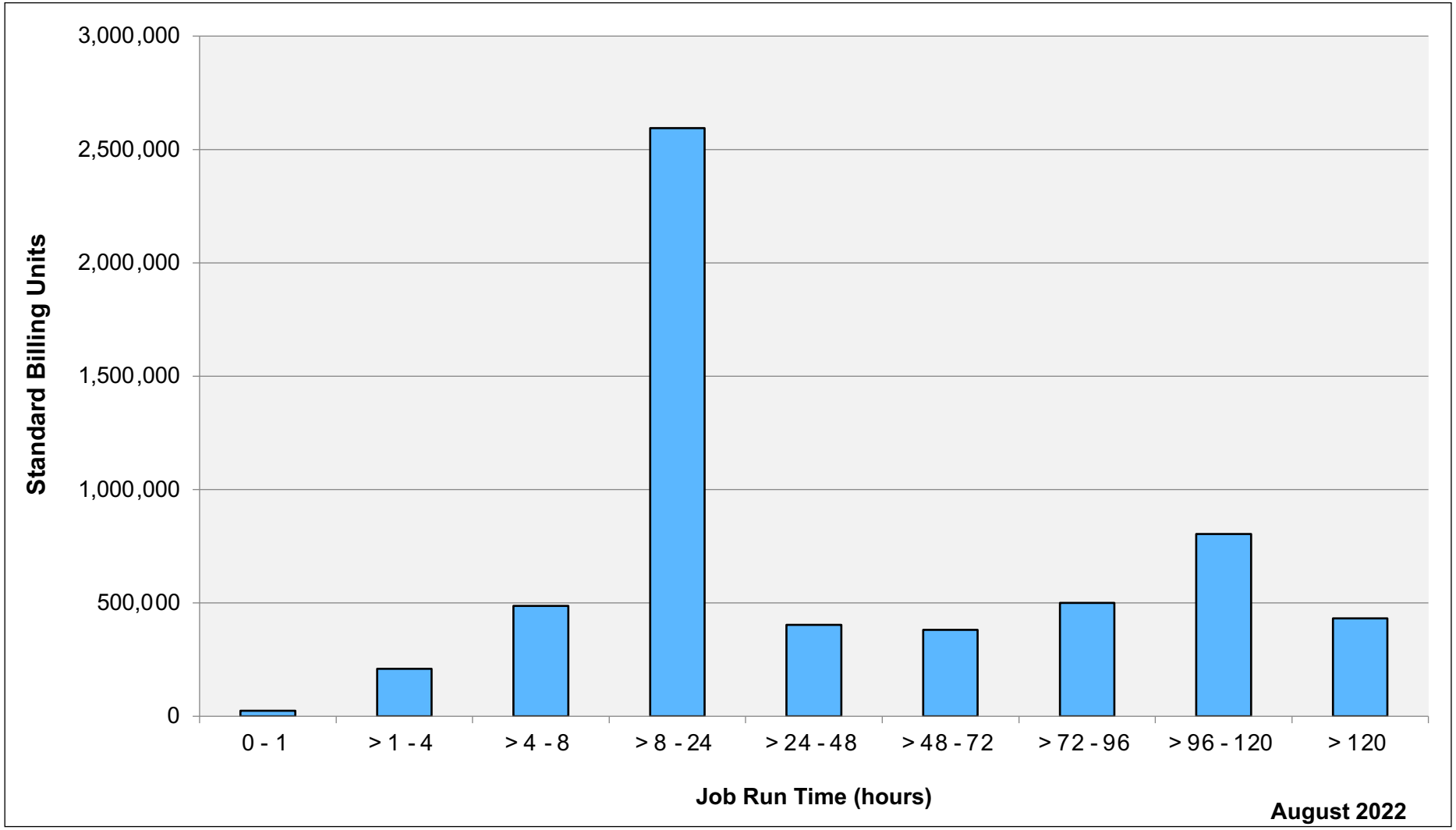
Aitken: SBUs Reported, Normalized to 30-Day Month



Aitken: Devel Queue Utilization



Aitken: Monthly Utilization by Job Length



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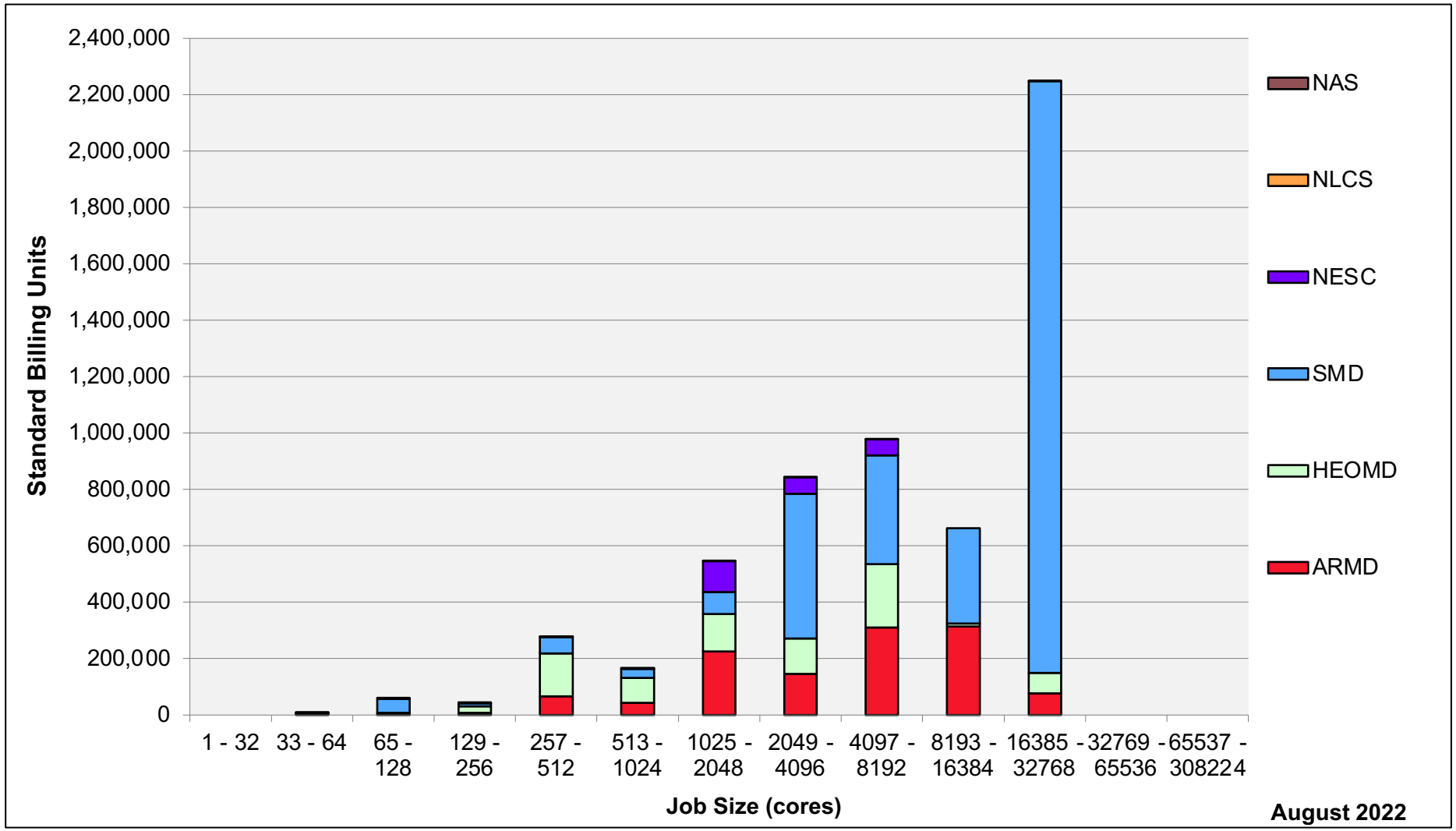

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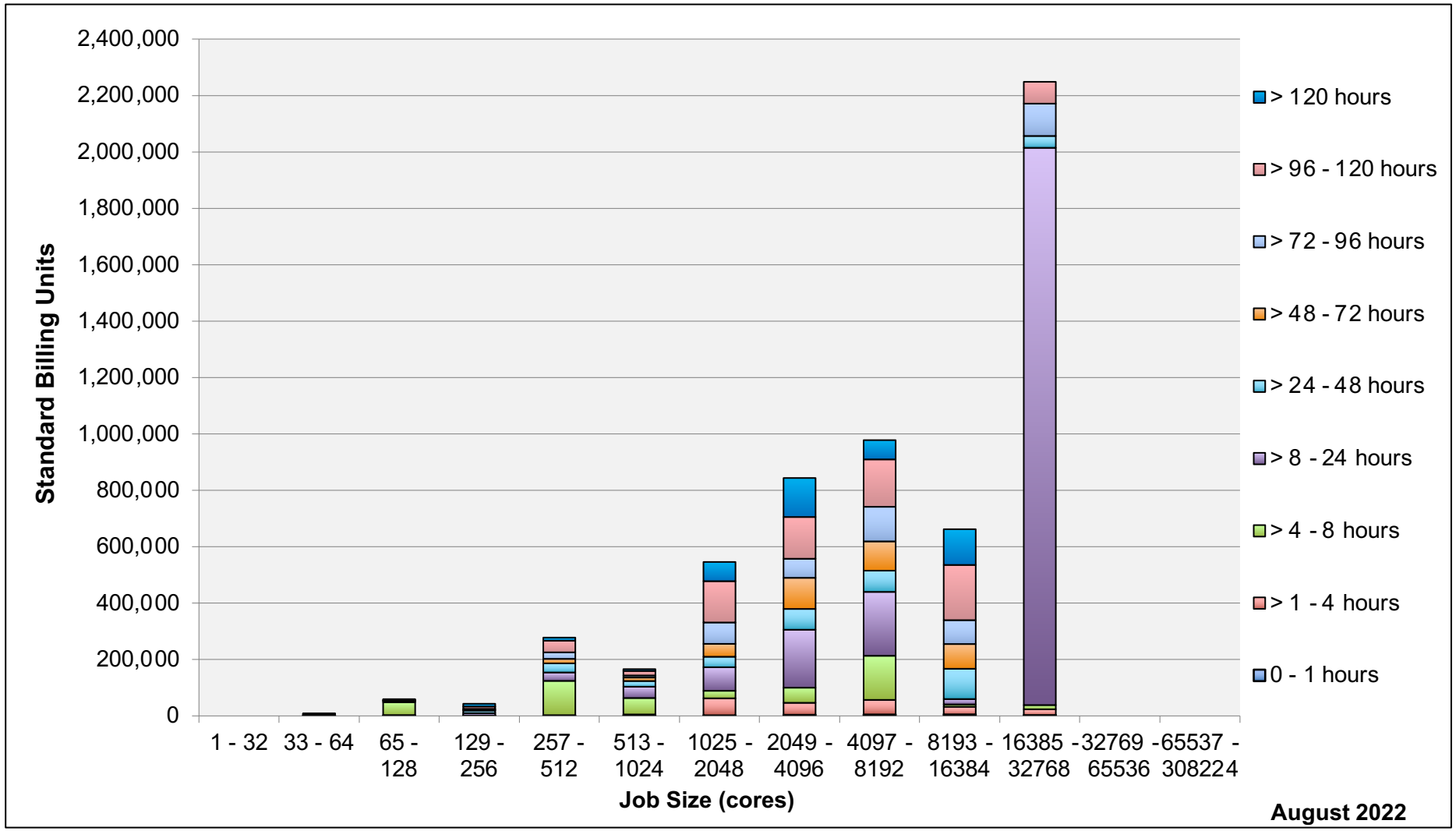
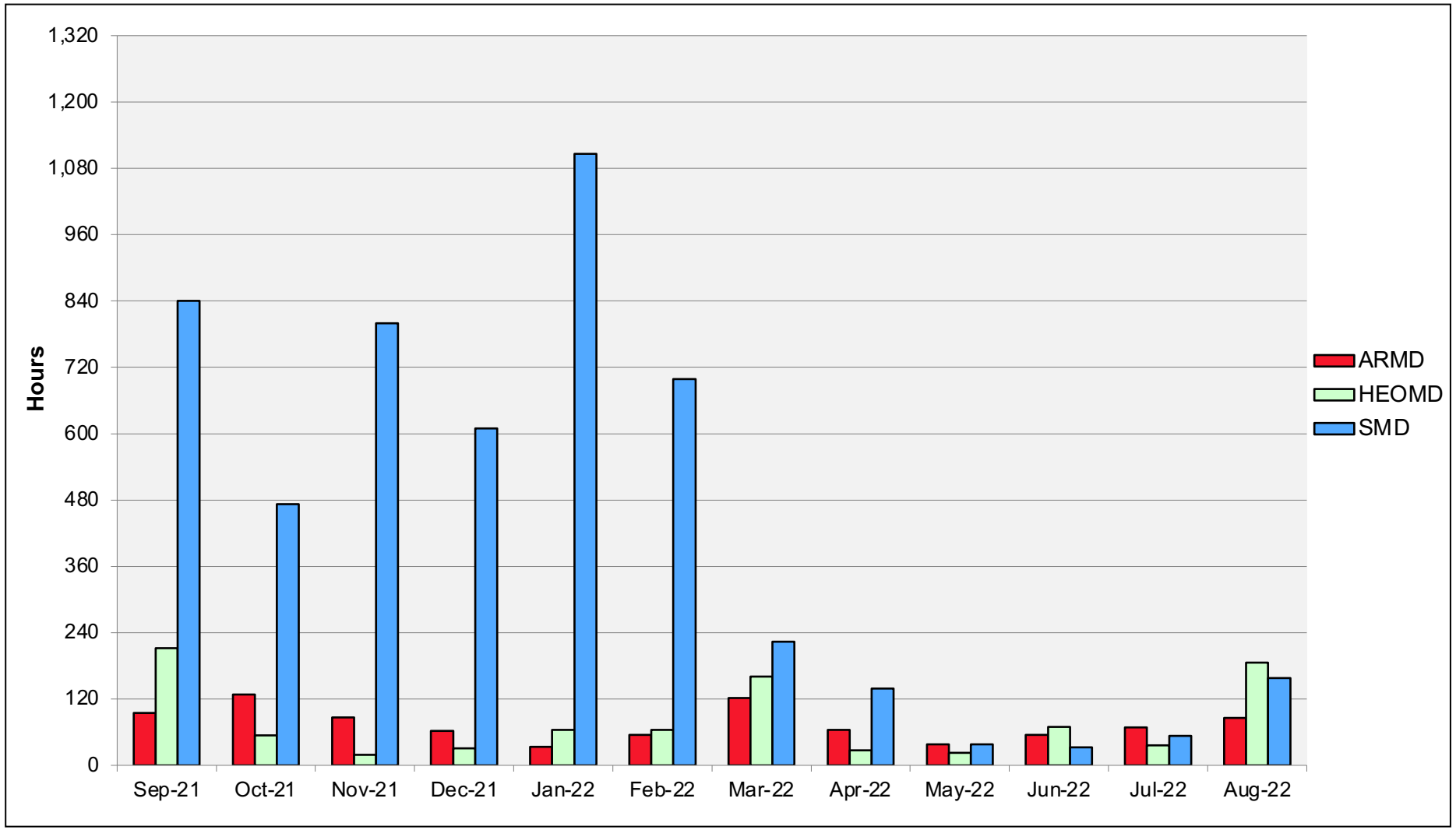
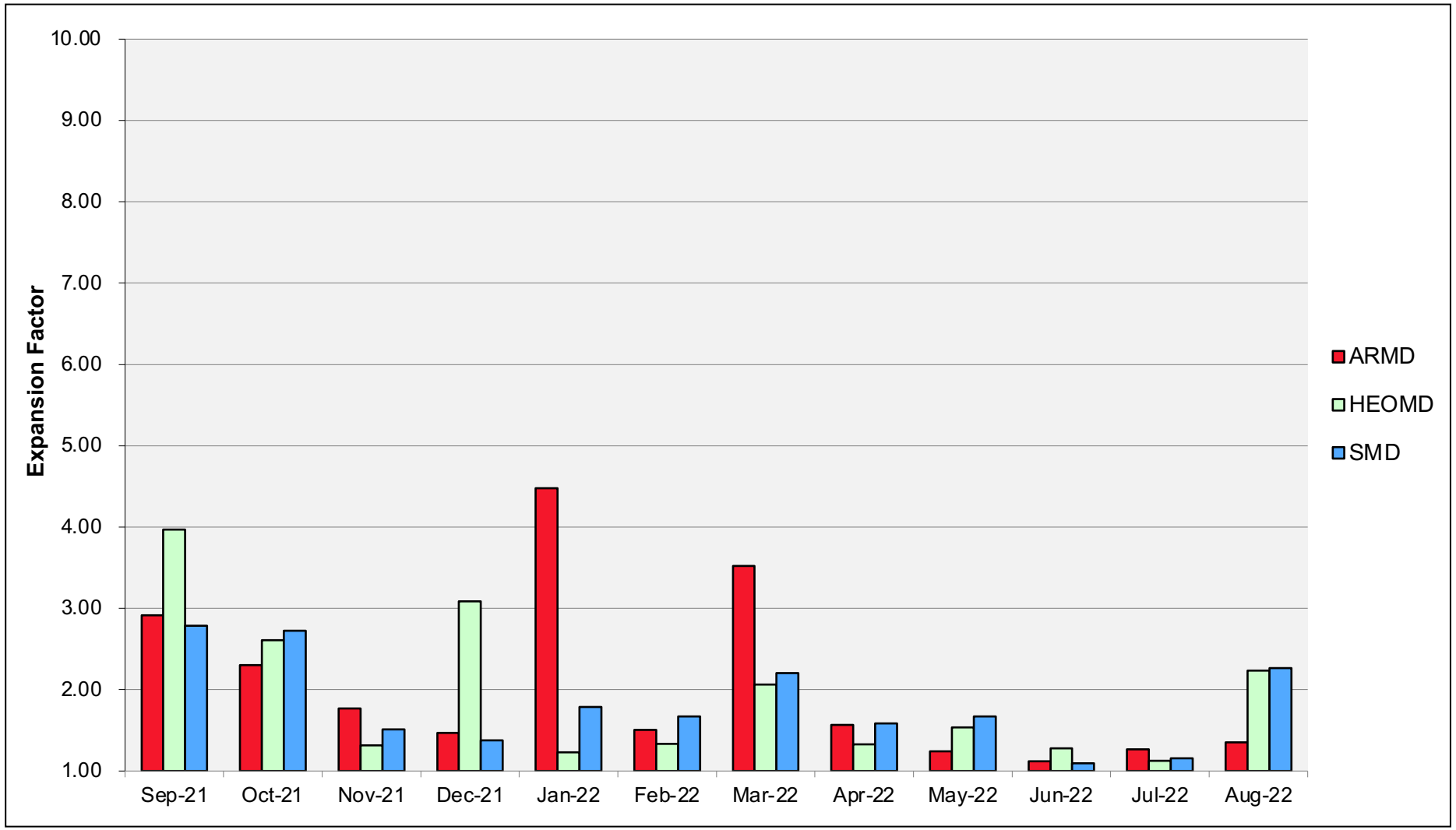


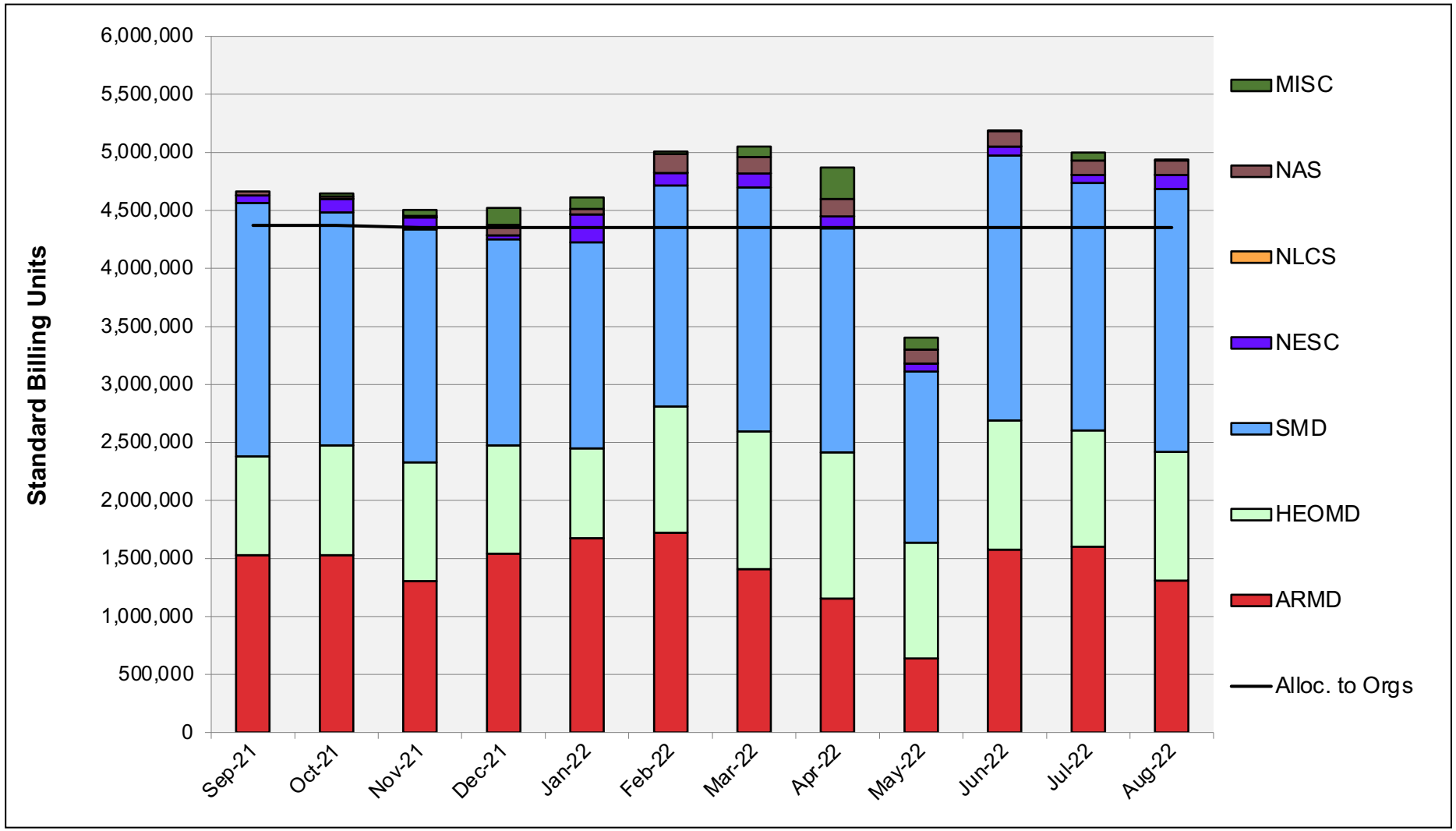
Aitken: Average Time to Clear All Jobs



Aitken: Average Expansion Factor



Pleiades: SBUs Reported, Normalized to 30-Day Month



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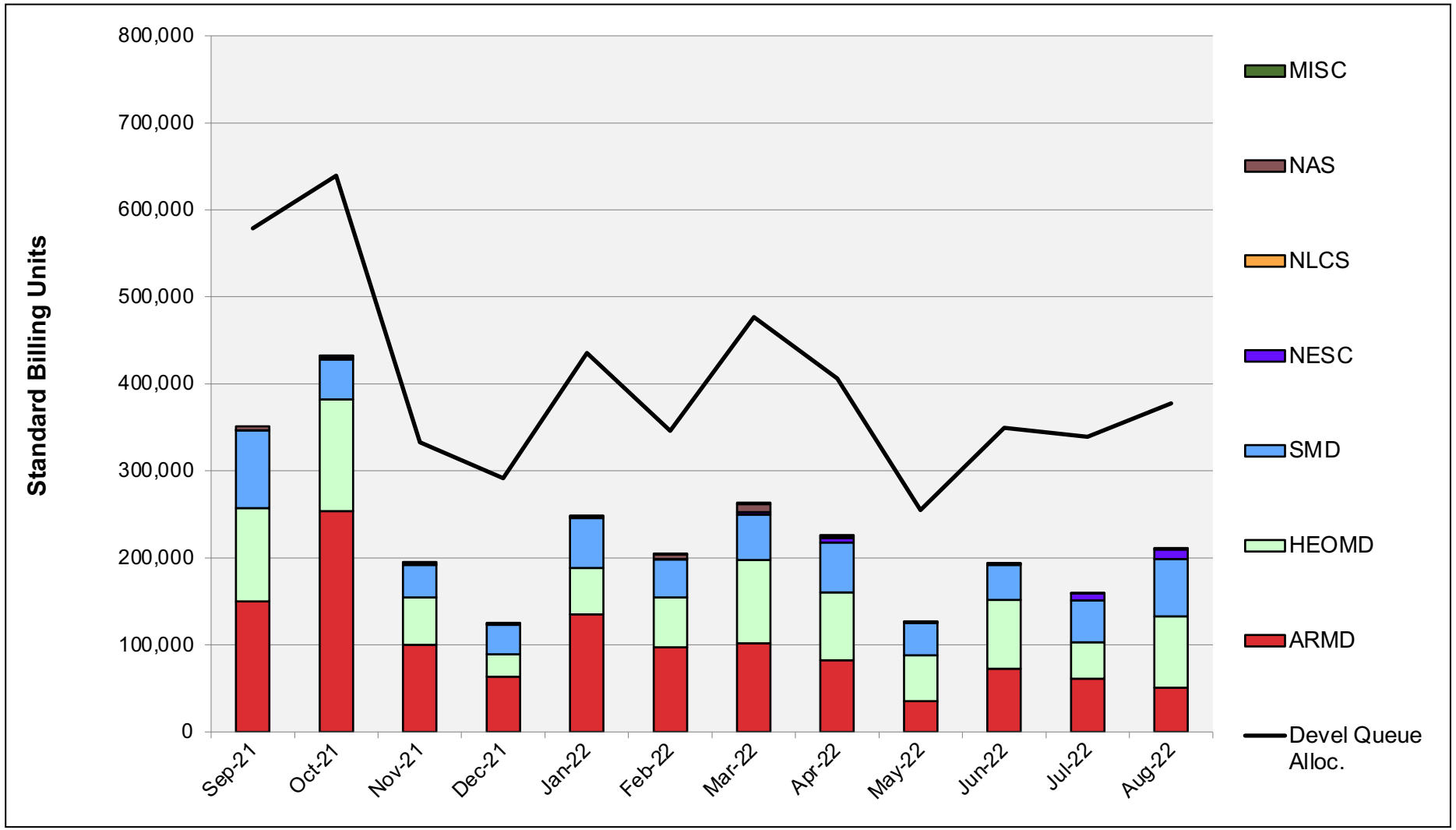

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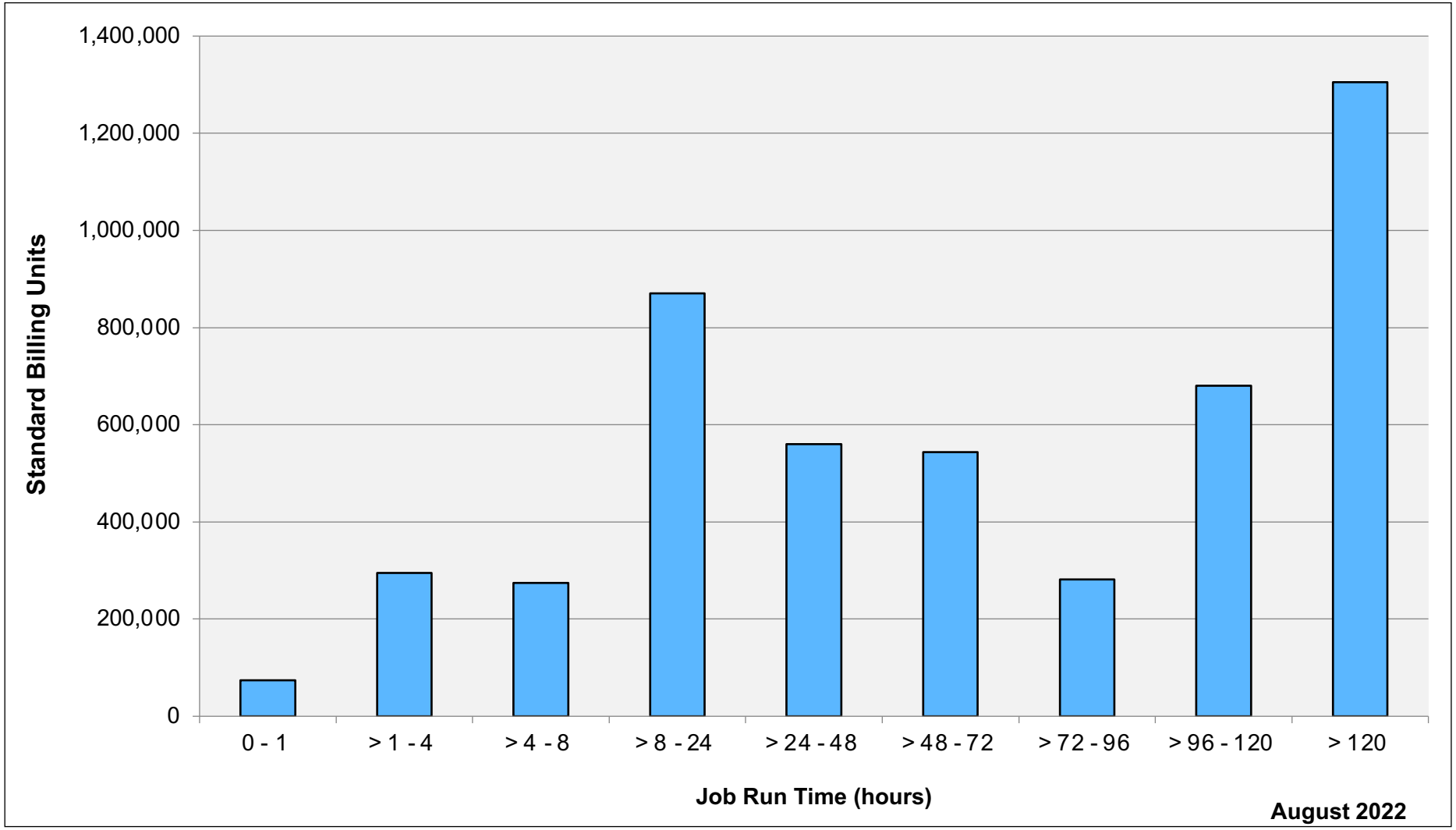

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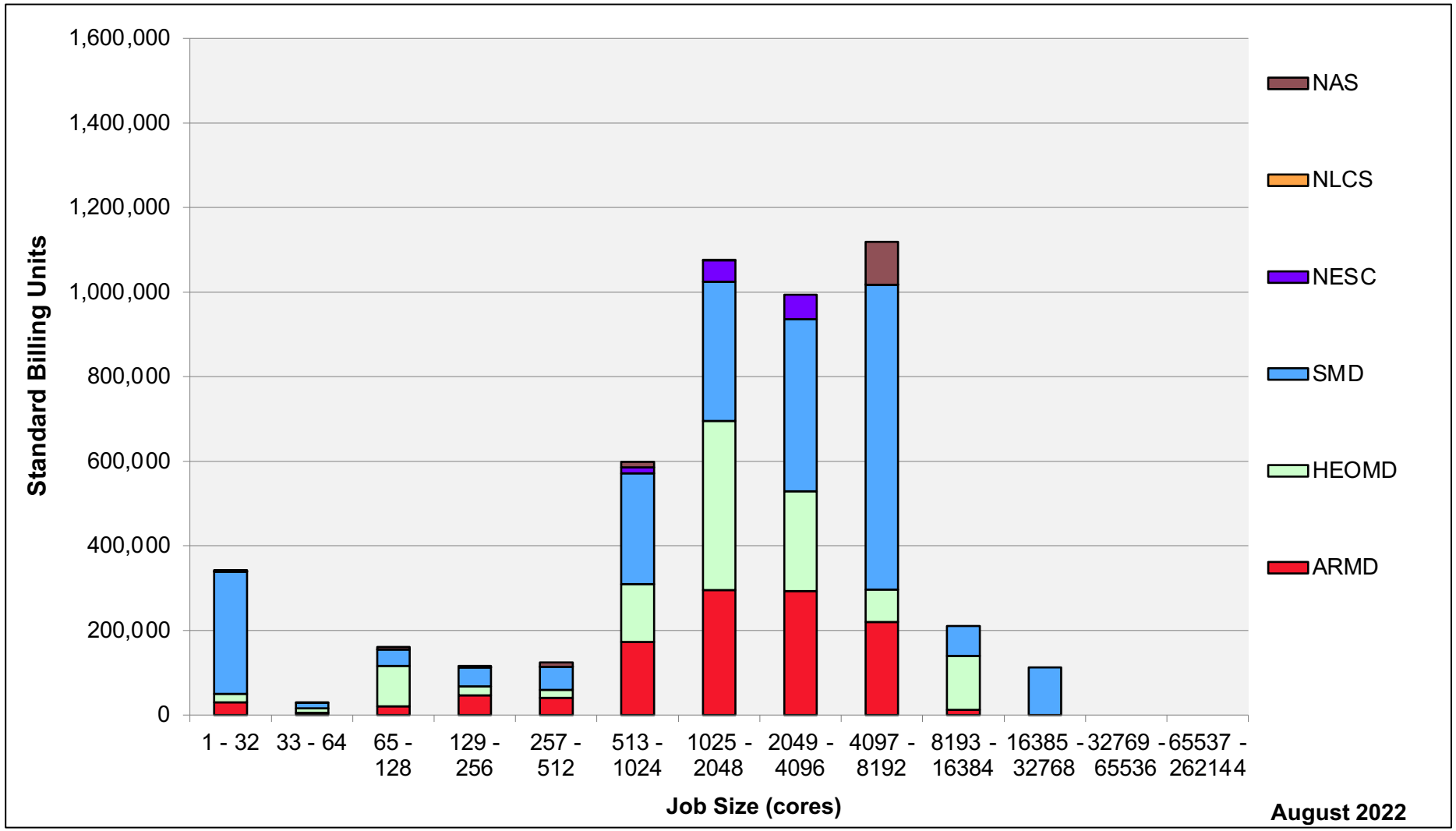

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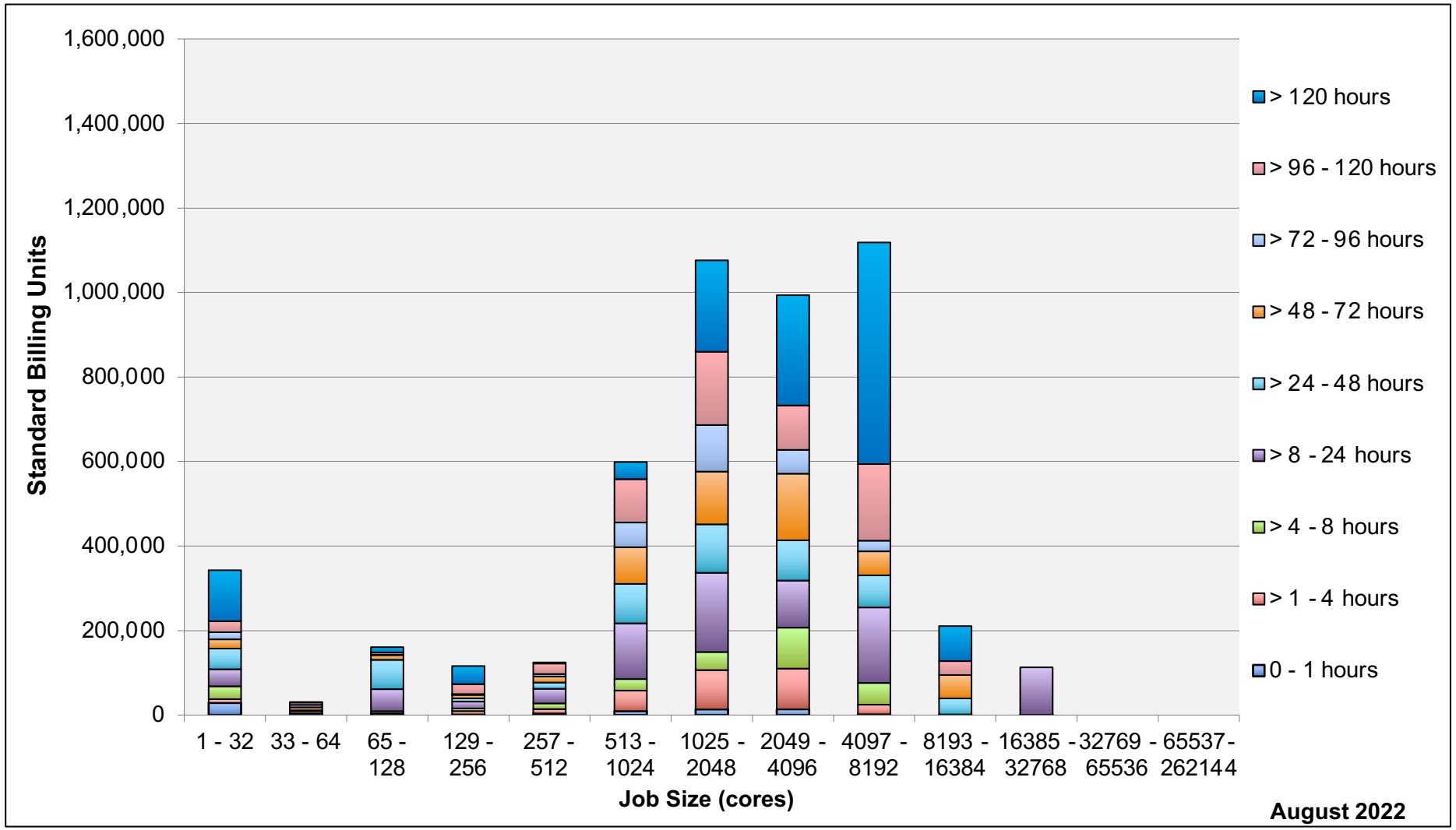

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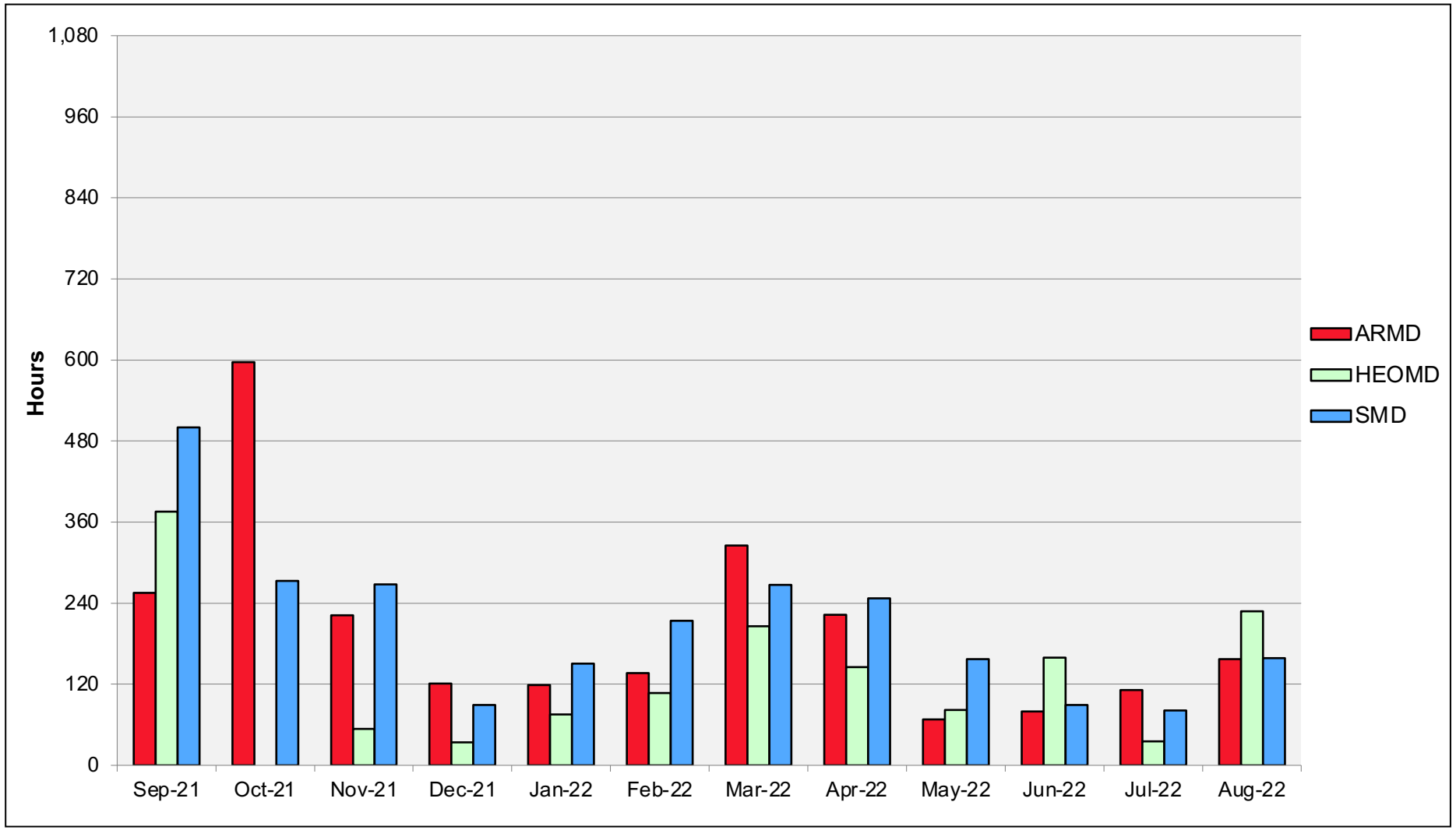
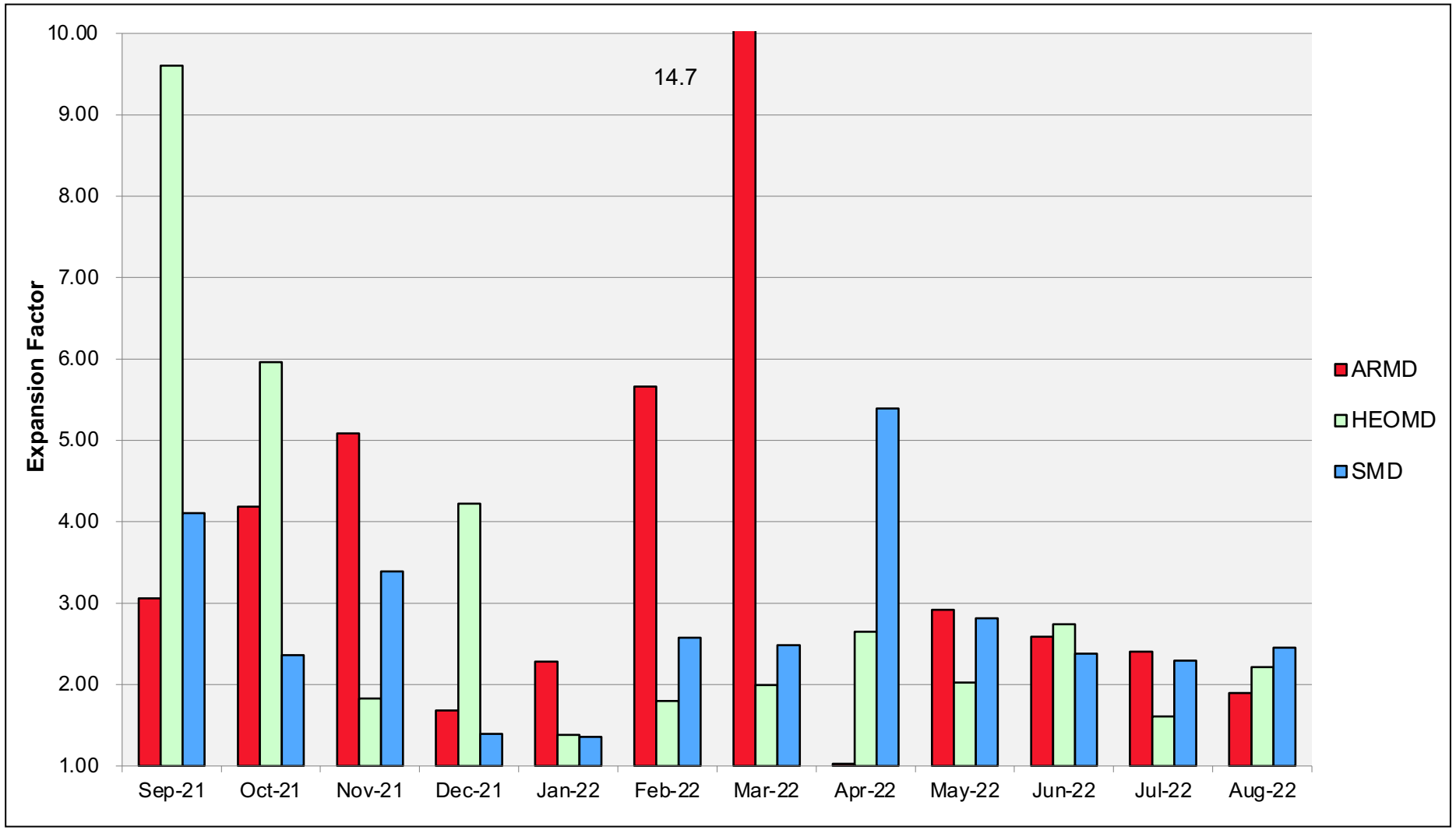


Pleiades: Average Expansion Factor



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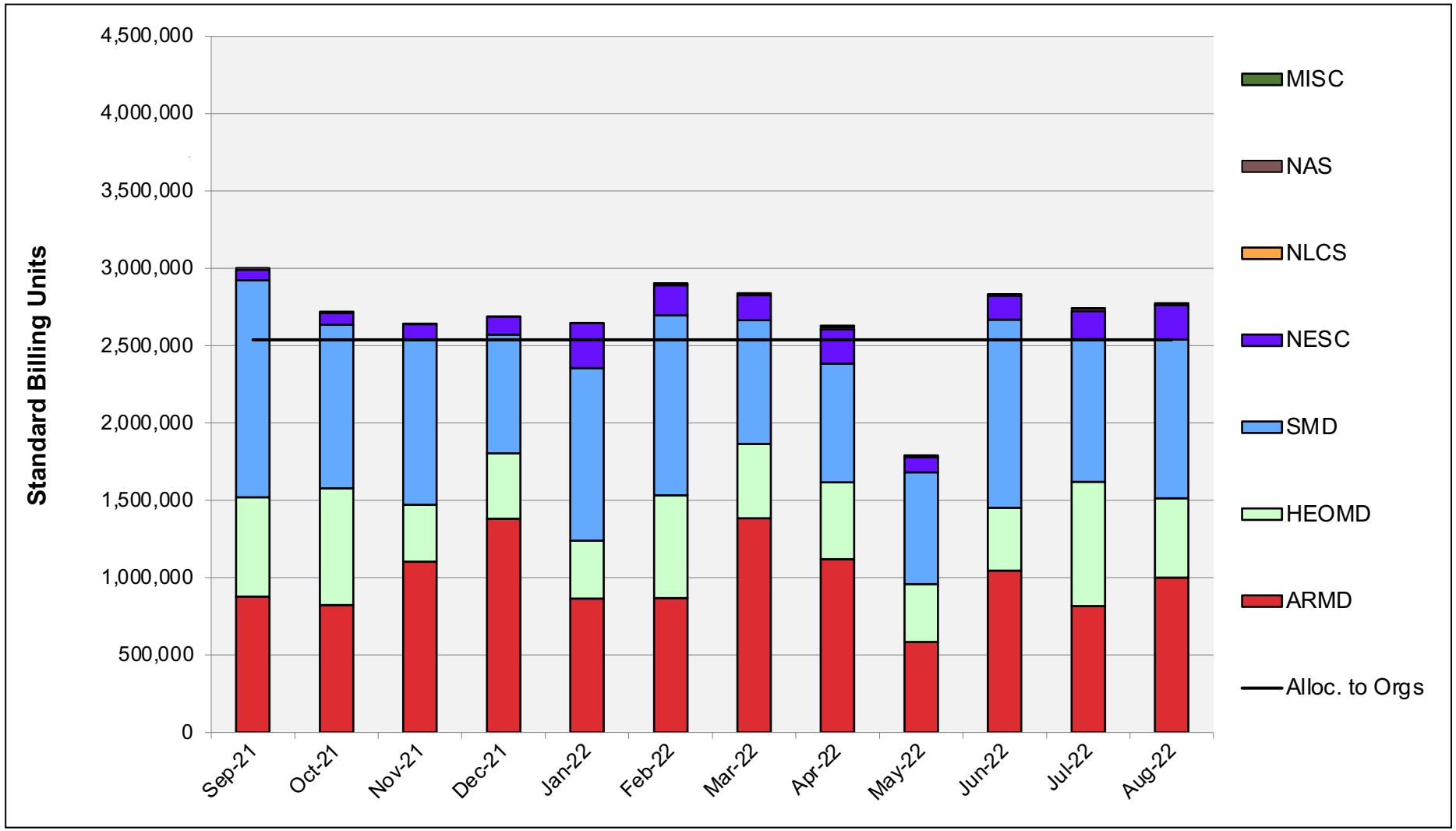

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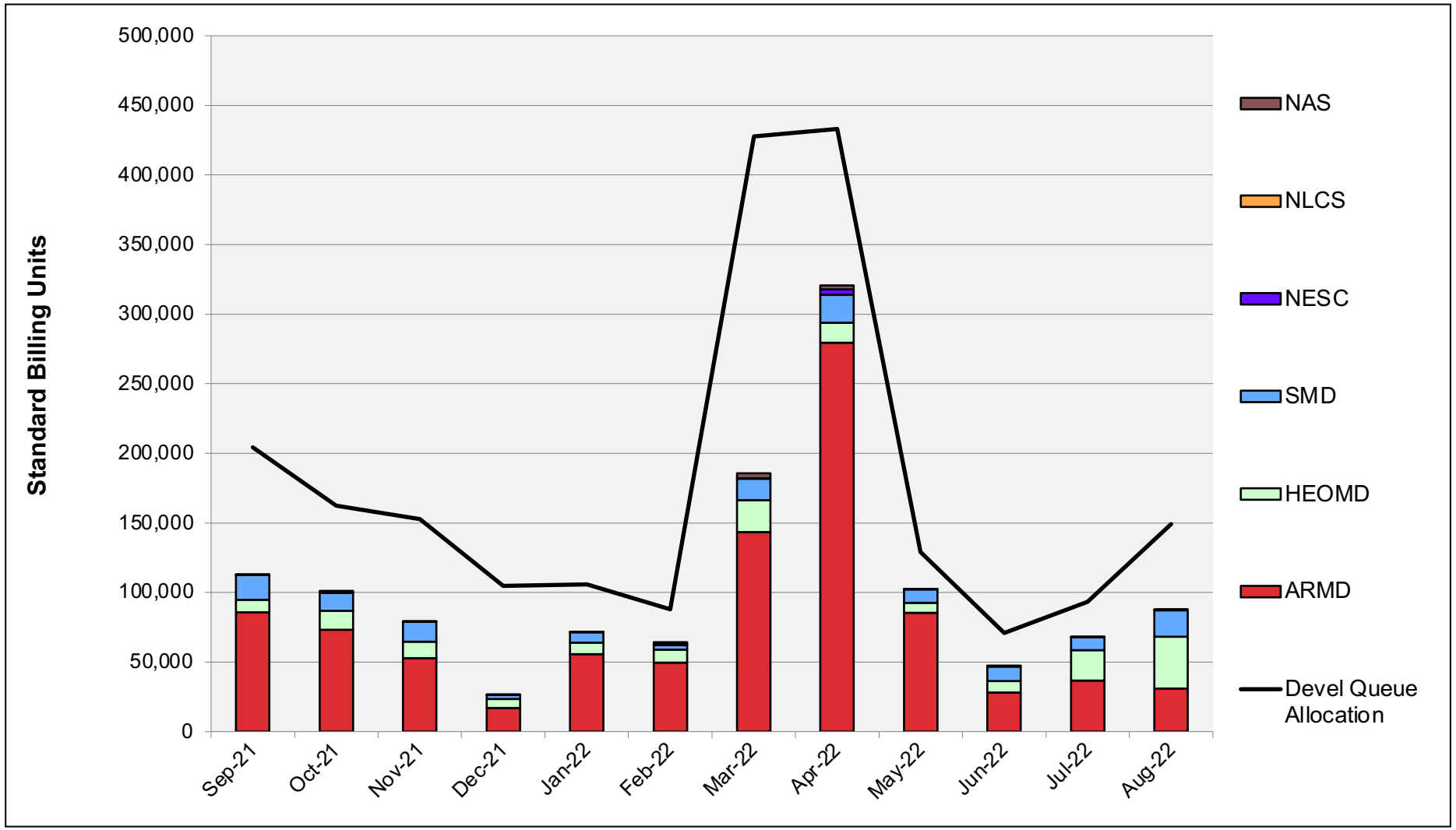

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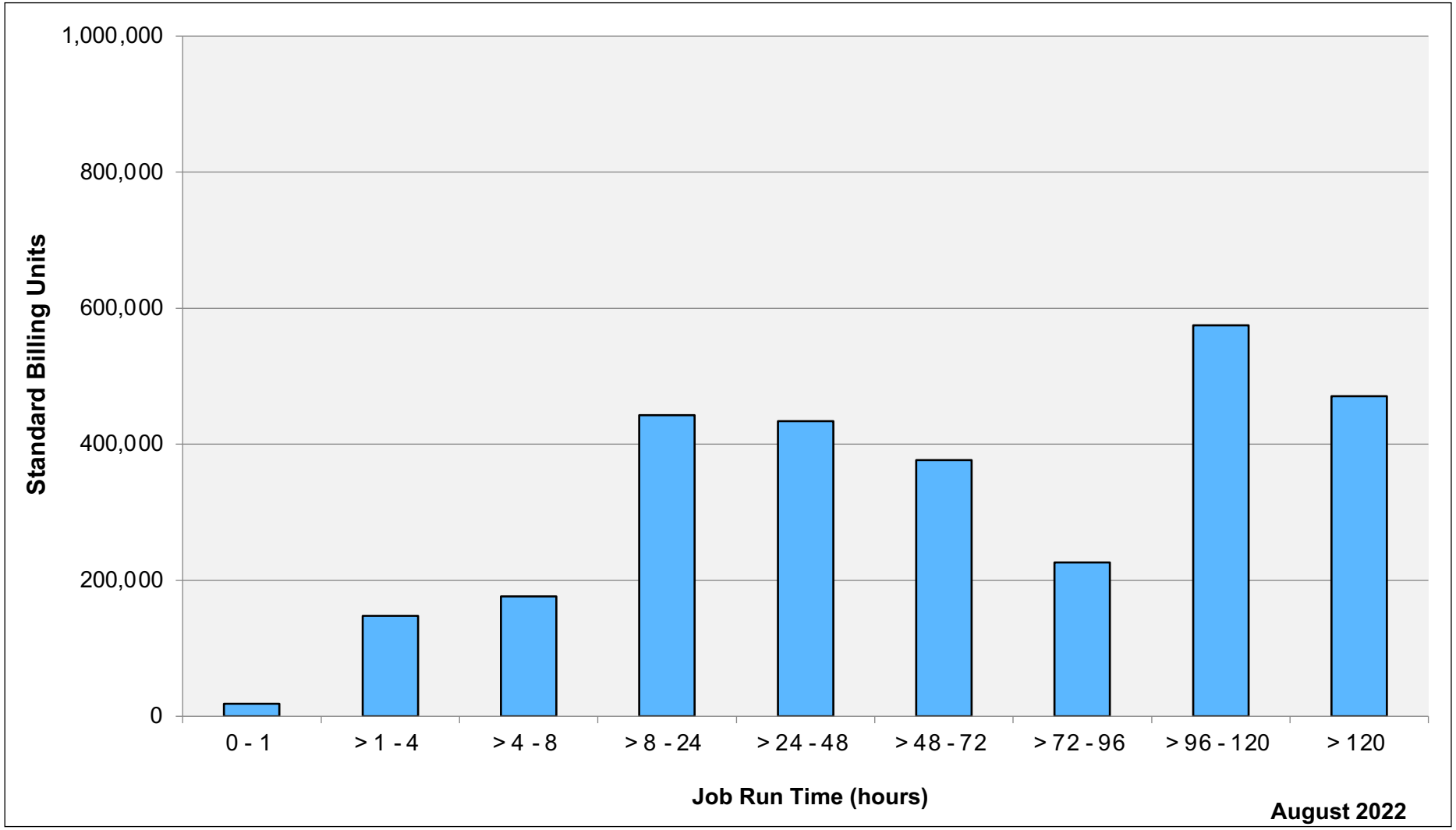

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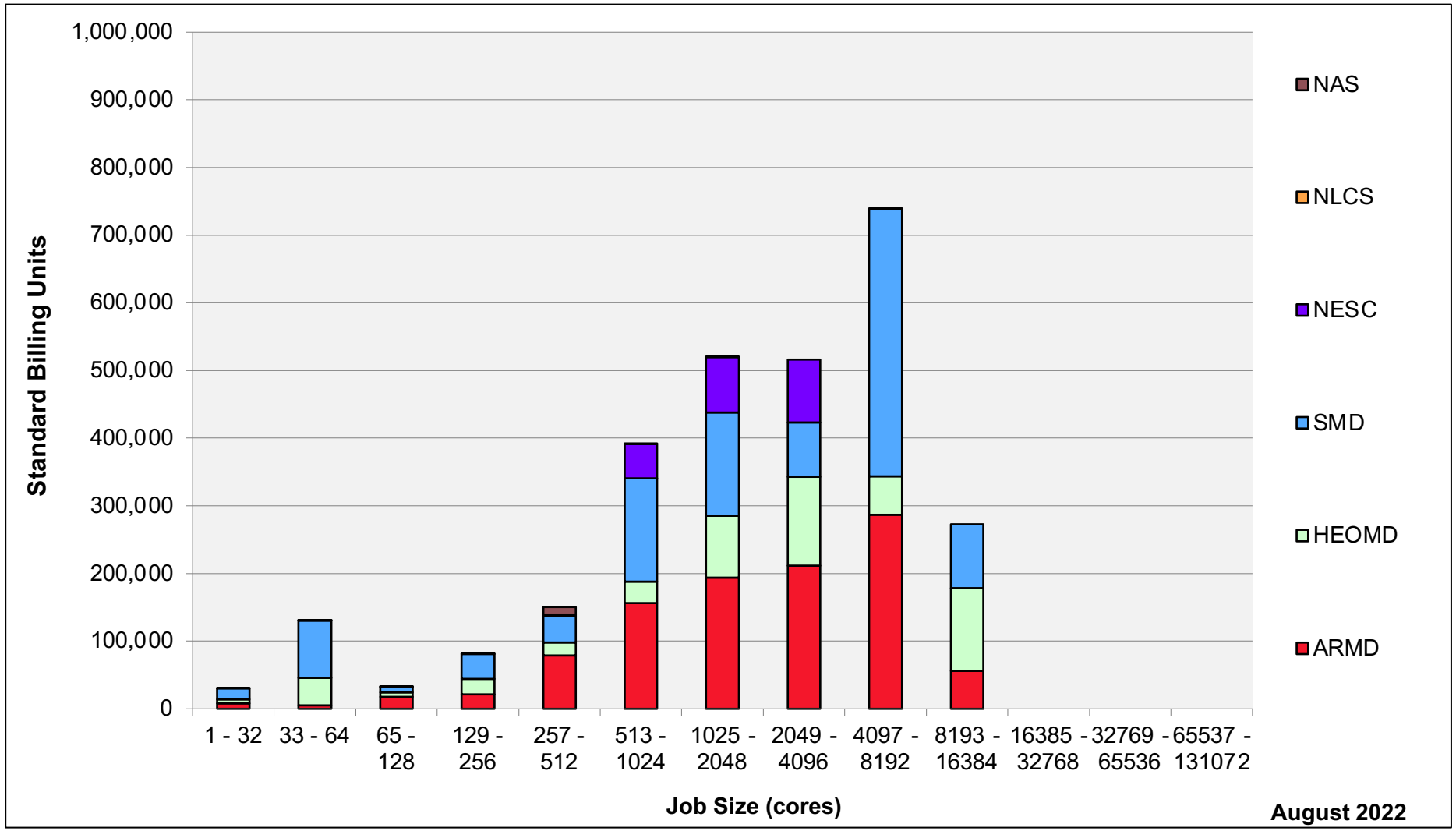
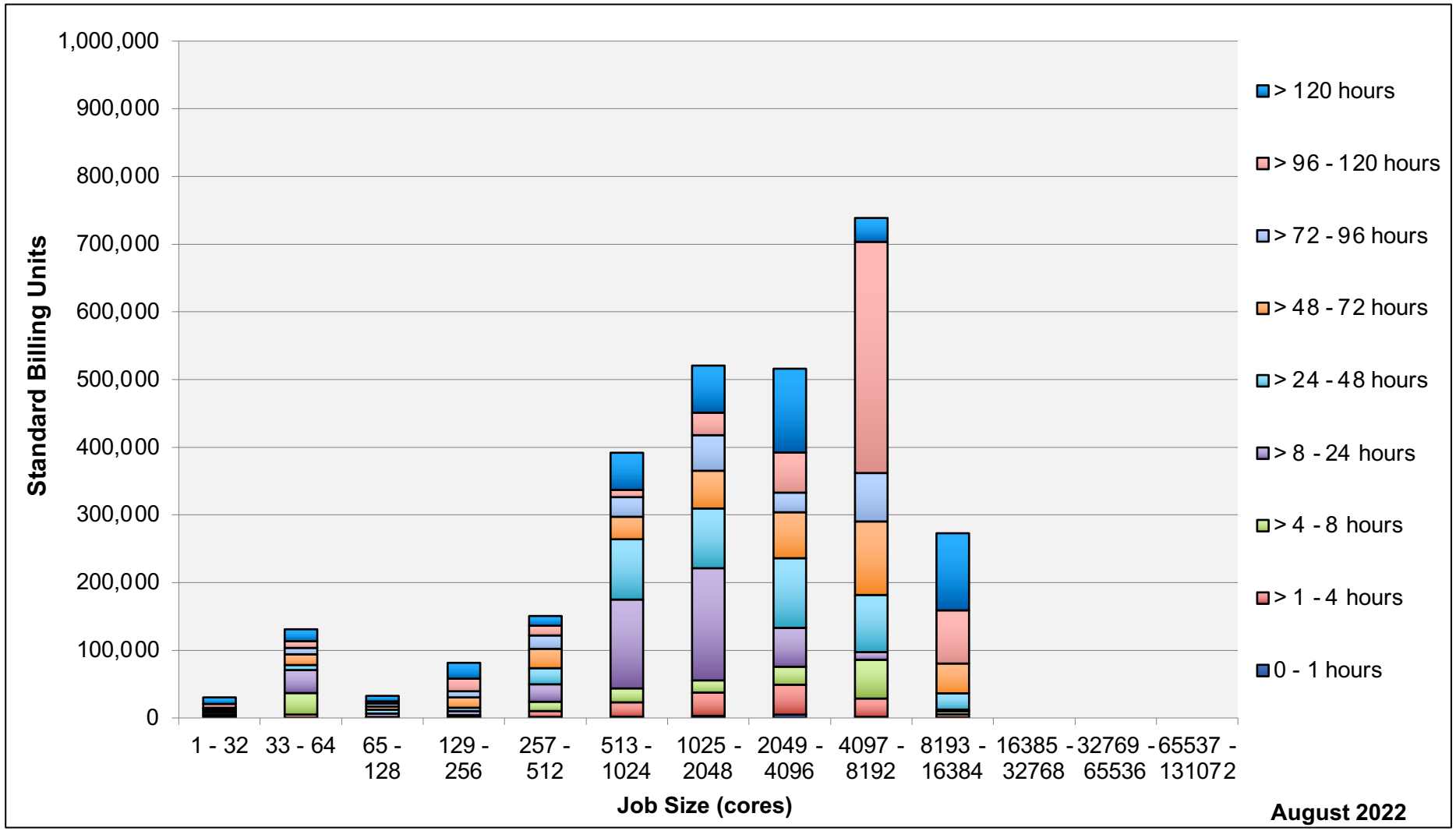
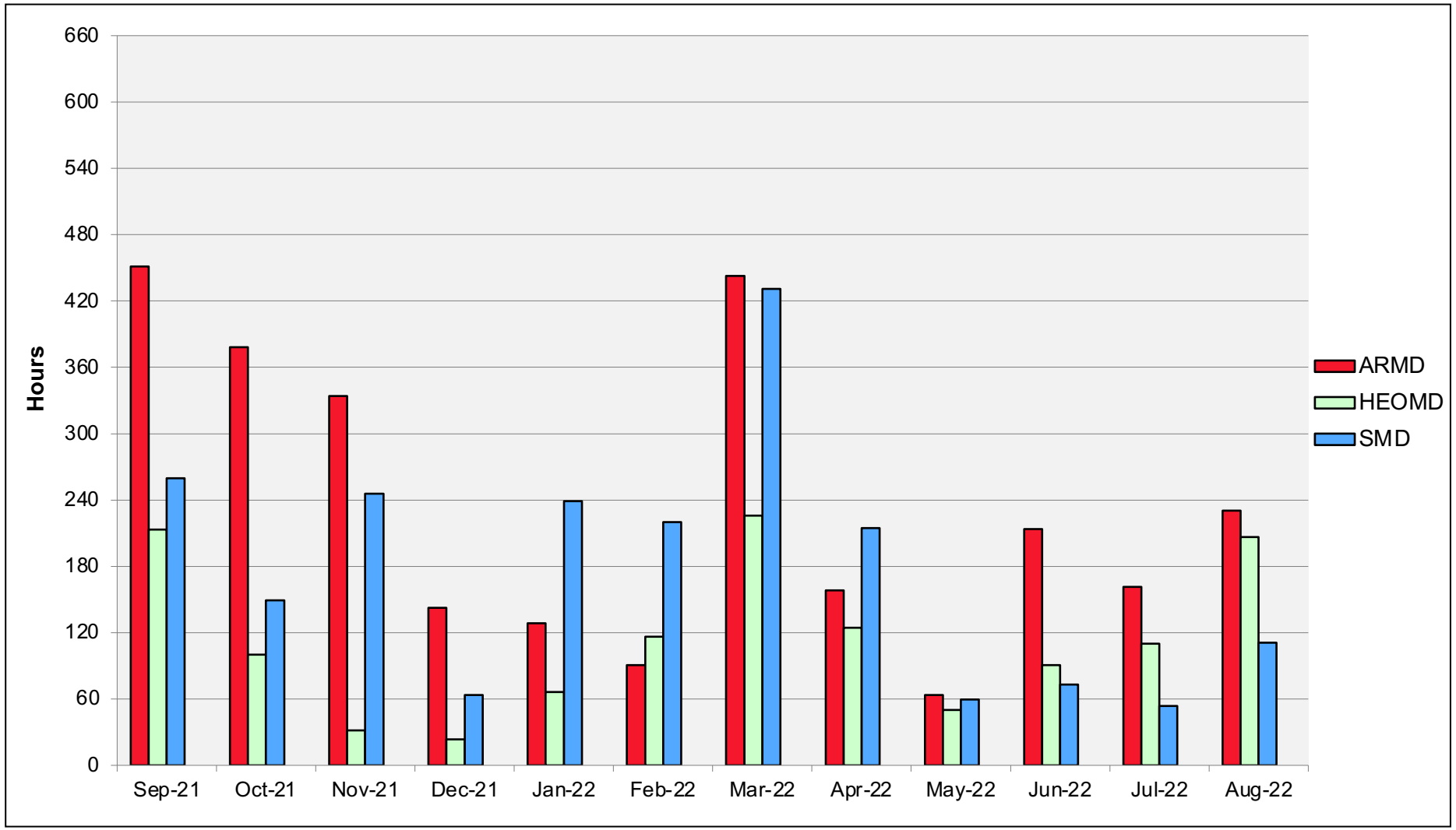


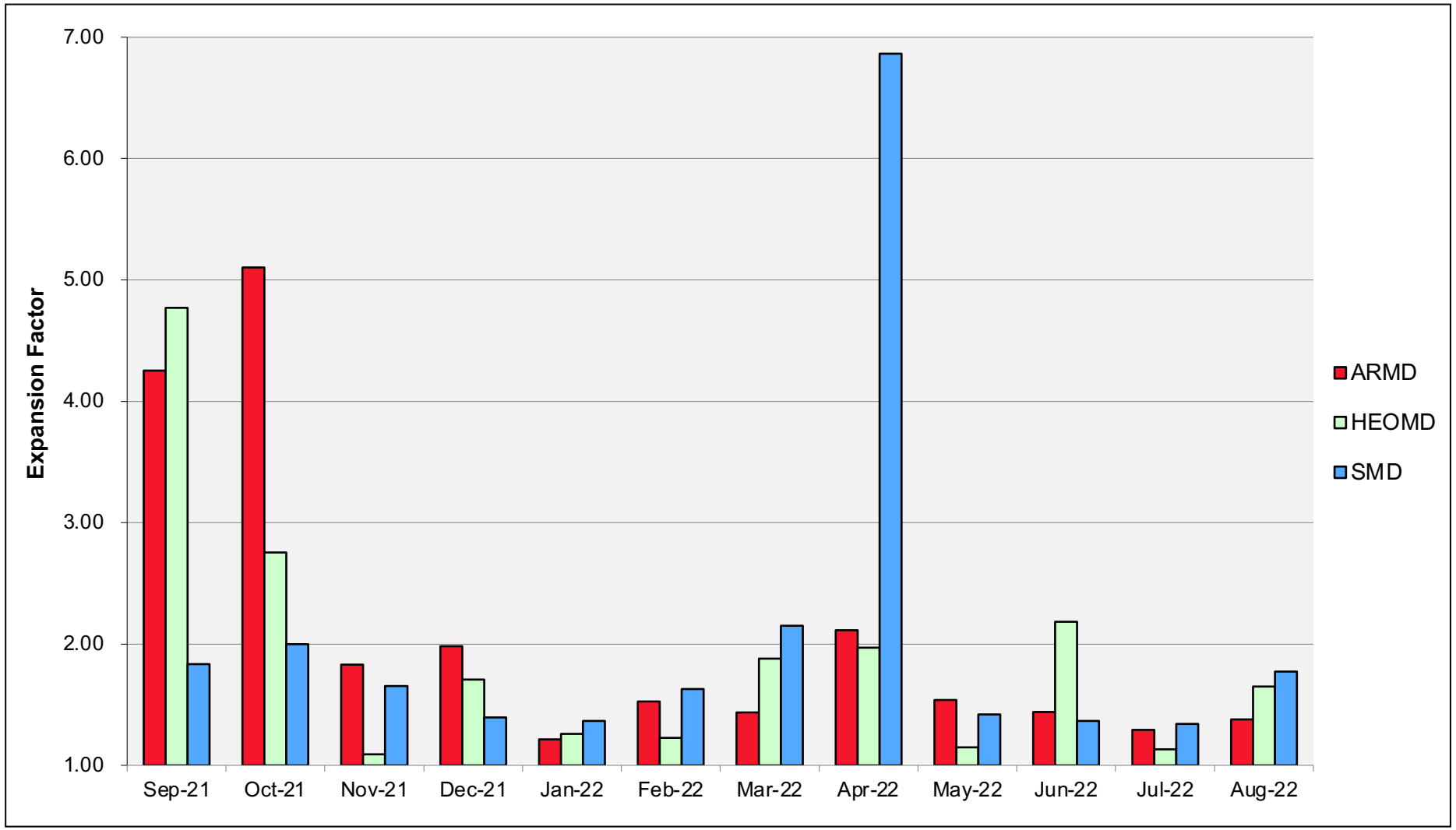
Electra: Monthly Utilization by Size and Length



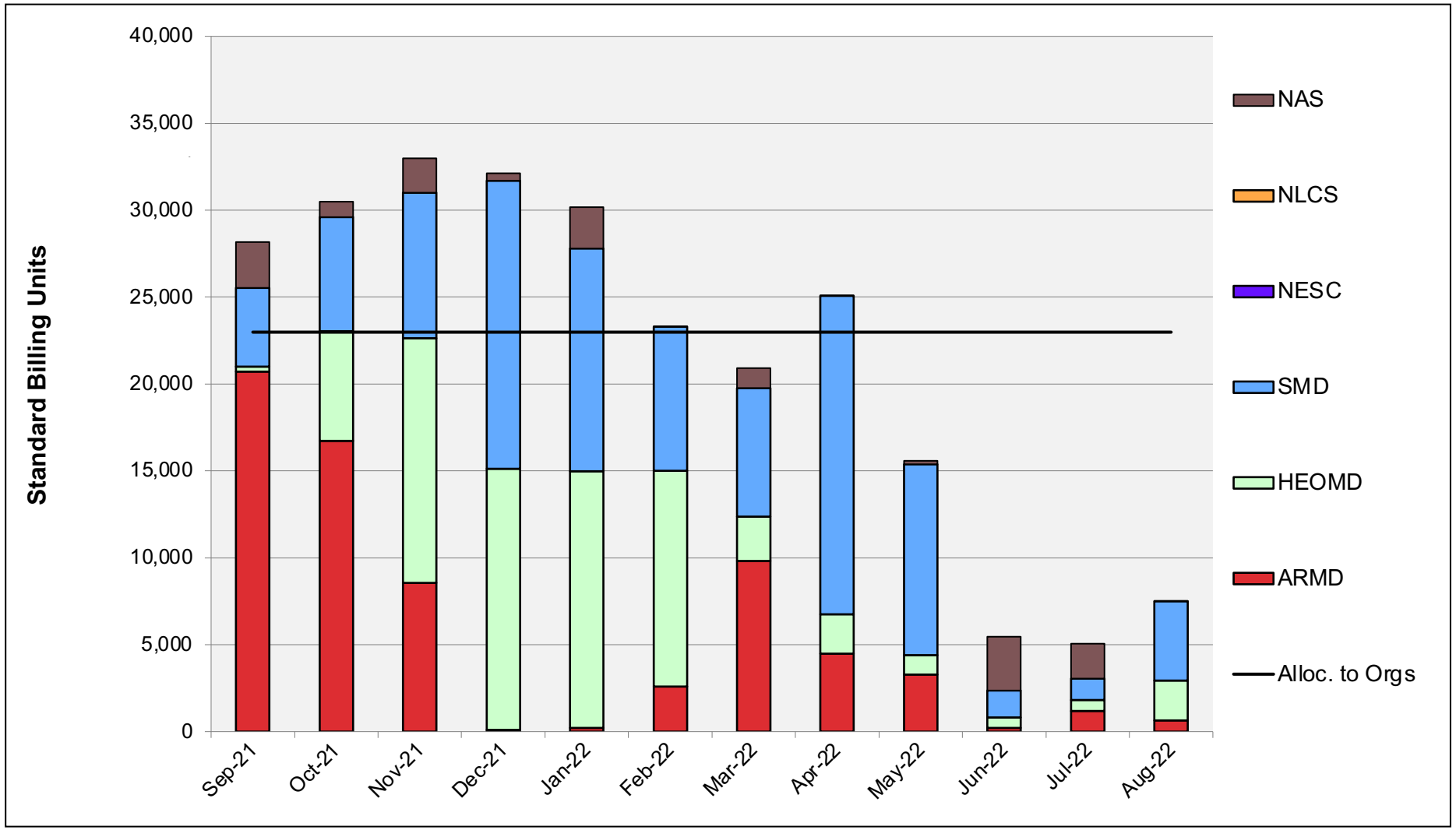
Electra: Average Time to Clear All Jobs



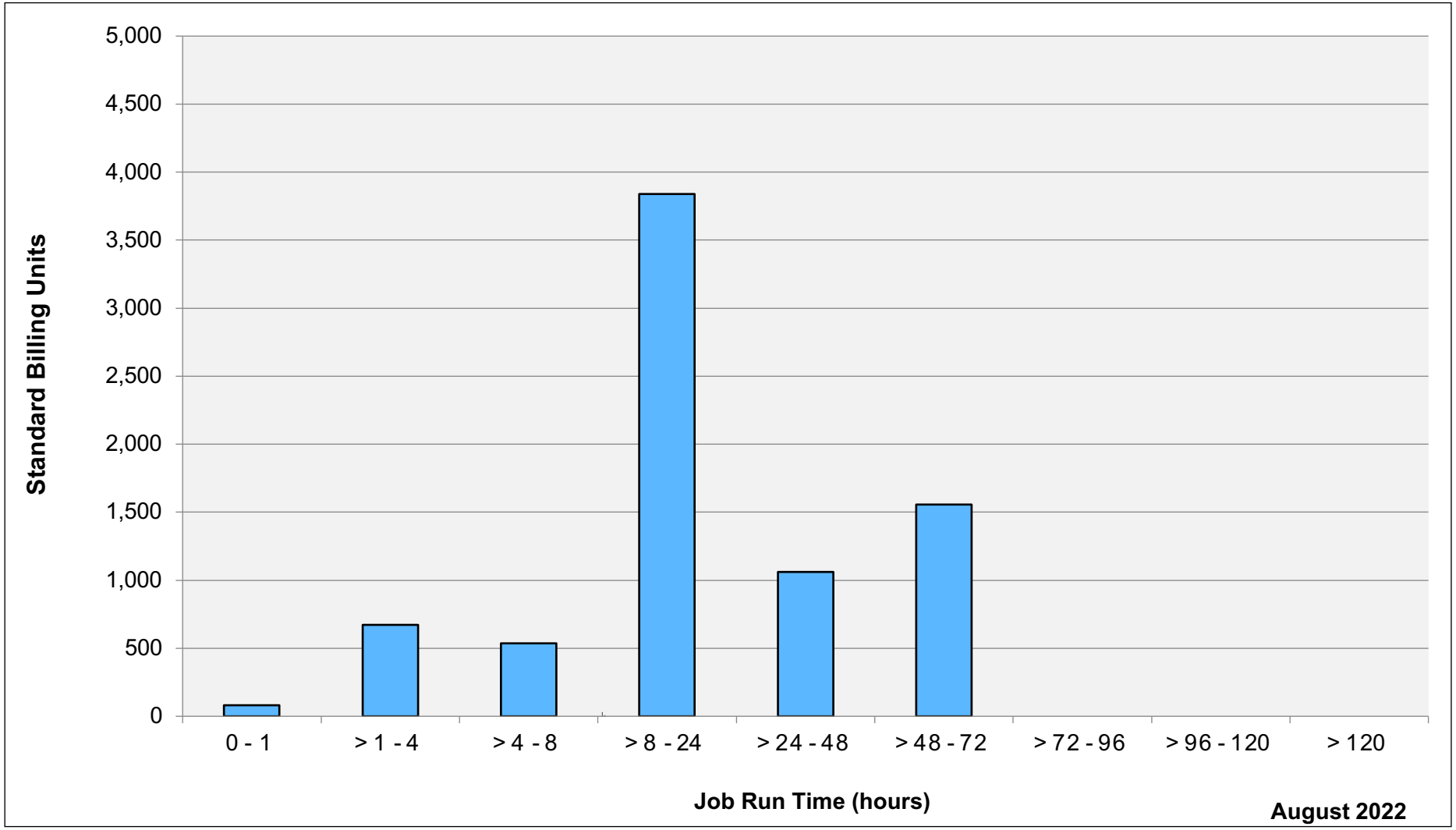
Electra: Average Expansion Factor



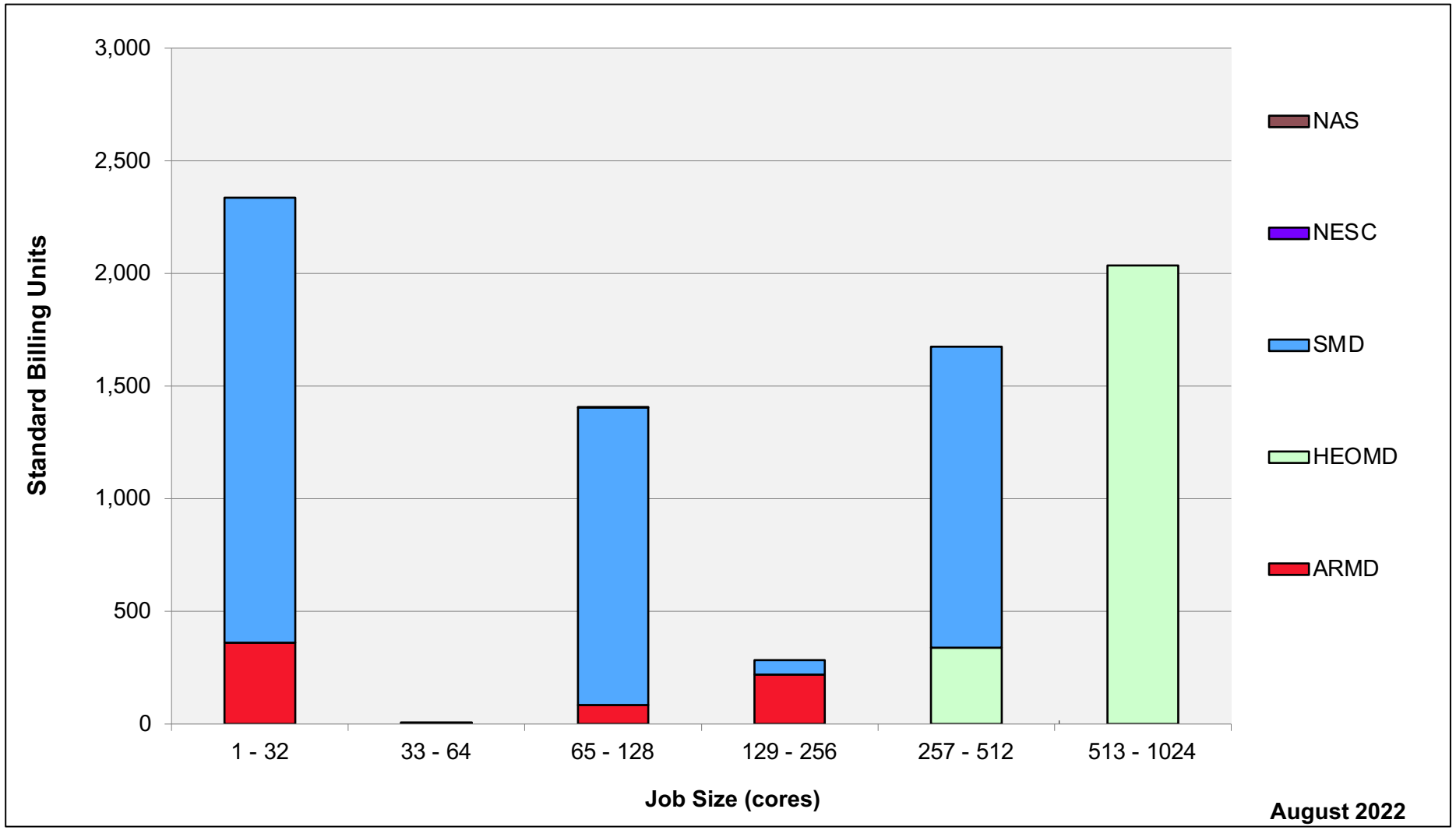
Endeavour: SBUs Reported, Normalized to 30-Day Month



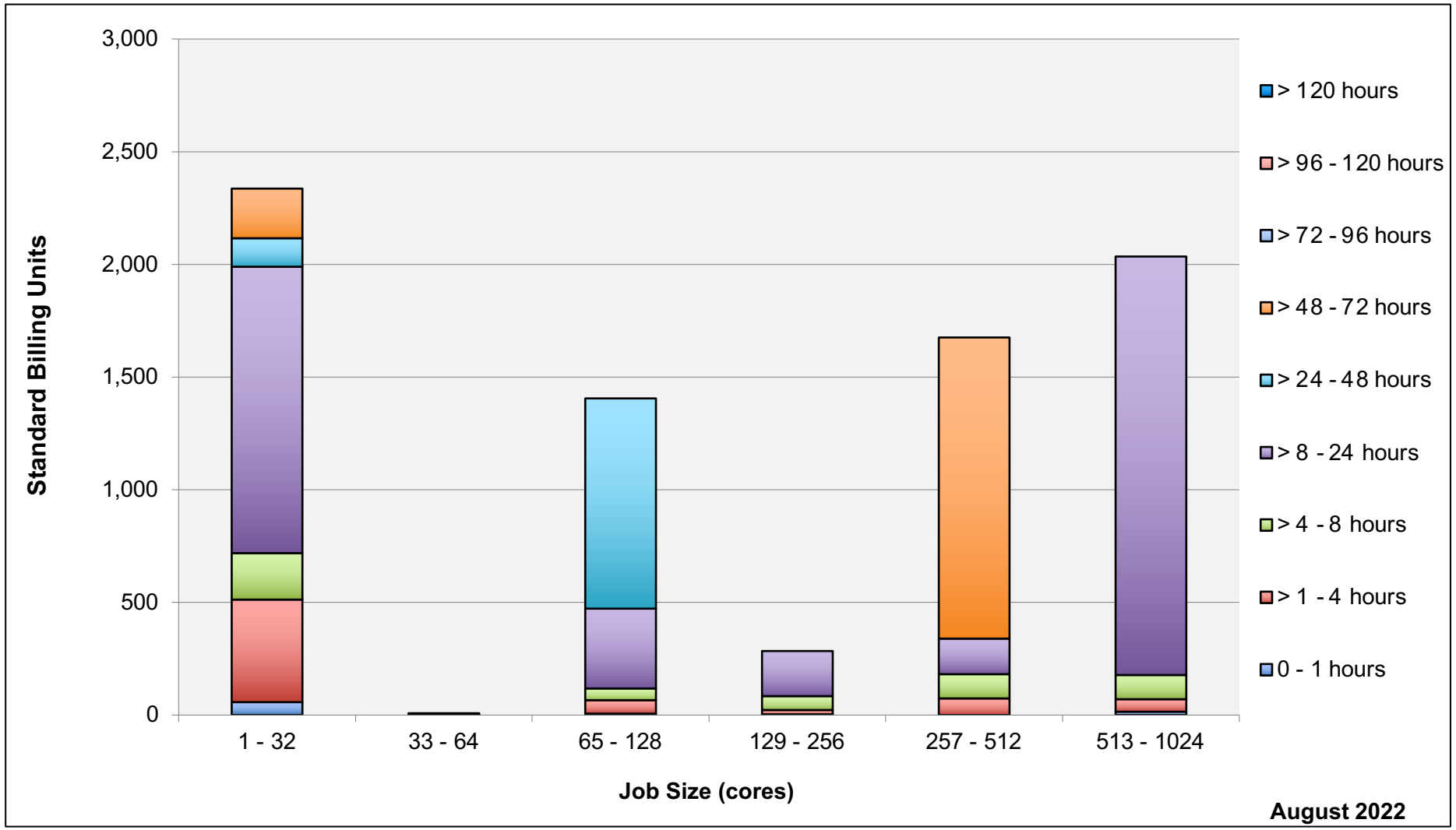
Endeavour: Monthly Utilization by Job Length



Endeavour: Monthly Utilization by Job Size



Endeavour: Monthly Utilization by Size and Length



Endeavour: Average Expansion Factor